AMATEUR RADIO

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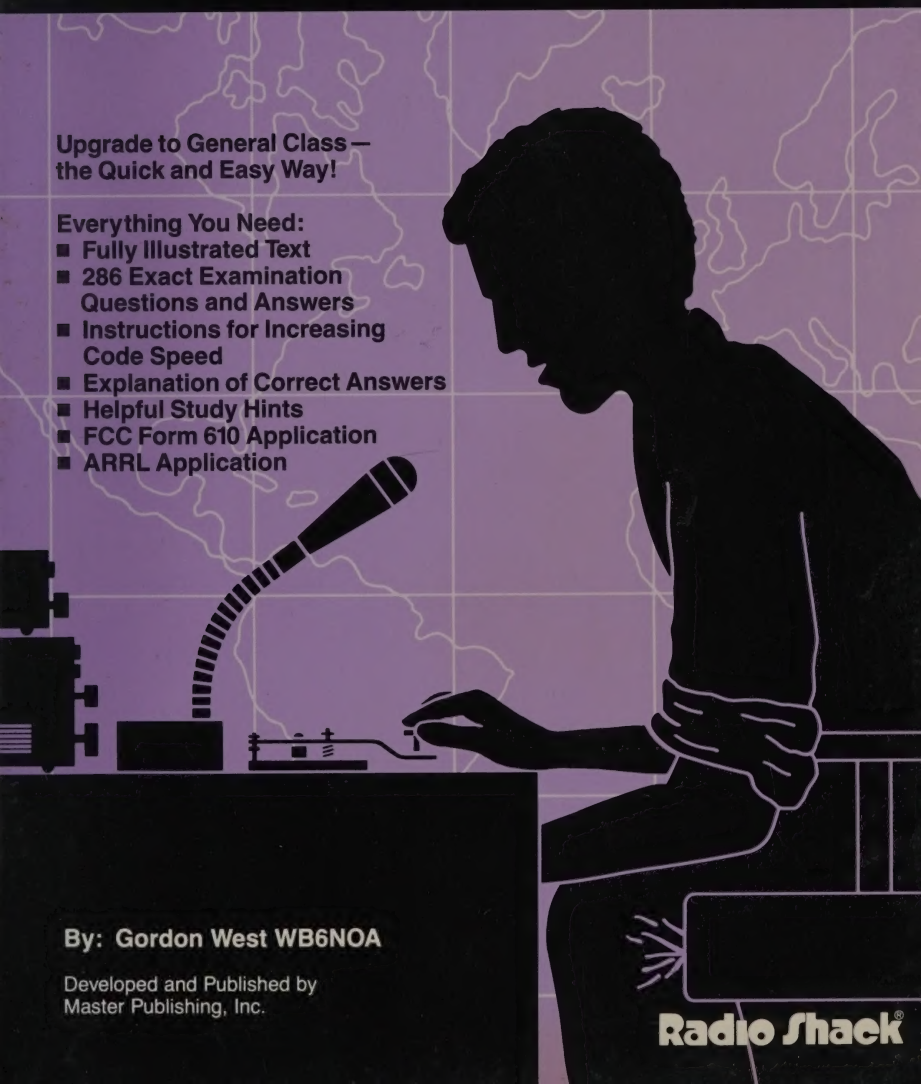
SECOND EDITION
With November 1, 1990
286 Question Pool

NEW
General Class
FCC License Preparation



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Everything You Need:

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- Instructions for Increasing Code Speed
- Explanation of Correct Answers
- Helpful Study Hints
- FCC Form 610 Application
- ARRL Application

By: Gordon West WB6NOA

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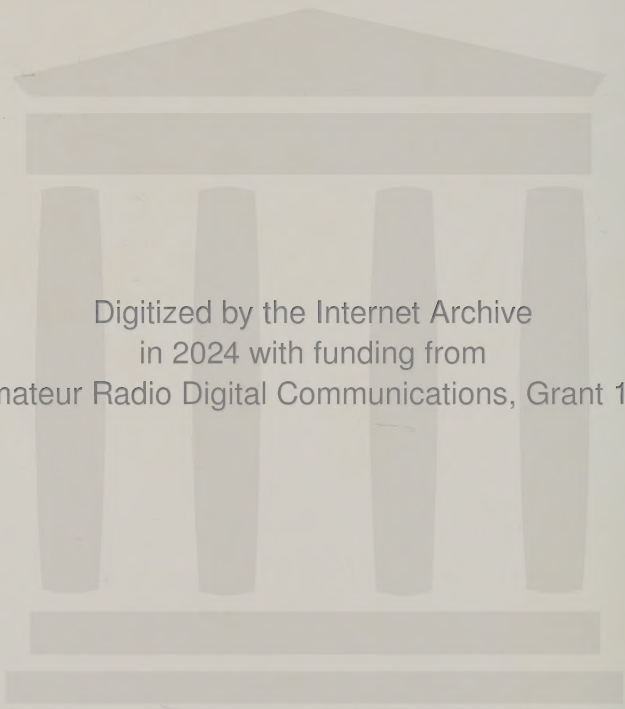

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BY
GORDON WEST WB6N0A

SECOND EDITION

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9 8 7 6 5 4 3 2 1

Table of Contents

ABOUT THIS EDITION

The latest nomenclature changes recommended by the Volunteer Examiner Coordinator's Question Pool Committee (QPC) for question pools effective July 1, 1990 have been incorporated in this book. We have attempted to follow the QPC's instructions in every detail. Many of the changes have been made globally based on the general rules from the QPC, both in text and in the question pool proper. For example, "Amateur Radio" is capitalized, "Amateur Radio Service" is now "amateur service," "Amateur Radio Operator" is now "amateur operator," "Amateur Radio Communications" is now "amateur communications," etc. And the definitions of amateur service, amateur-satellite service, and RACES—the three services that now make up Amateur Radio services—have changed.

Obviously, our interpretation and implementation may be different from other publishers; therefore, there may be variations in some of the question pool wording. We hope that any slight differences will not contribute to improper understanding of the question or it's answer. In our opinion, they should not.

Preface

Welcome to your gateway for worldwide voice communications. The General Class amateur operator/primary station license allows you to operate on worldwide frequency bands to communicate throughout the world. With the General Class license, you may run the maximum legal amount of power out—1500 watts. You can operate any type of emission within the suggested band plans—telegraphy, voice, television, radioteleprinter, and packet.

The General Class license still allows two General Class operators, 18 years of age or older, to administer Novice Class examinations. General Class operators may also *assist* accredited VEs with the new codeless Technician examinations. The General operator may also help prepare Novice code and Novice theory examinations.

If you are a traveler, the General Class license lets you stay in voice contact anywhere you go. Whether you ply the South Seas in international waters, or cruise the highways in North America, you can always stay in touch with the General Class license.

All of these new privileges are added to those you already enjoy in the Novice and Technician Class bands. You may go on the air immediately after passing the examination administered by three fellow ham volunteer examiners.

This book covers everything on the General Class, Element 3B, written examination. The code cassettes will help you build your speed to the required 13 wpm. Just 20 minutes of study a couple times a day will adequately prepare you for your General Class license in less than a month.

So what are you waiting for? Start with Chapter 1, then go to Chapter 2 and listen to the Preface on the code tapes. Chapter 3 contains all the possible questions, 25 of which will be on your examination. Chapter 4 tells you what to do before the exam. That's how easy this course is! We're glad you are continuing your license class advancement. Hear you on the worldwide bands!

Gordon West, WB6NOA

1

The General Class License

INTRODUCTION

The General Class amateur operator/primary station license, Element 3B, permits you to use segments of every worldwide band for long distance voice communications. You also keep all the privileges you now have as a Novice and Technician Class operator.

The General Class license has always been considered "the big one" because of the almost unlimited worldwide privileges this license gives you. While the Novice and Technician licenses give you a taste of VHF and UHF operations, Technician Plus only gives you a tiny slice of the 10-meter worldwide daytime band. With the General Class license, you receive operating privileges on every worldwide band that gives you day or night skywave coverage to just about anywhere in the world.

INCENTIVE LICENSING

The General Class license is the third step up the five successive levels of amateur operator licenses. Each step requires progressively higher levels of learning and proficiency, and each gives you additional operating privileges.

This method, known as *incentive licensing*, strengthens the amateur service by offering more privileges in exchange for more electronic knowledge and code skill. The theory and regulations covered in each of the questions for the various examinations relate to privileges that you will obtain when you upgrade. *Table 1-1* and *Table 1-2* are reminders for you. *Table 1-1* gives an overview of the classes and the examination requirements. *Table 1-2* details the subjects covered in the various written examination question elements.

Table 1-1. Amateur License Classes and Exam Requirements

License Class	Test Element	Type of Examination
Novice Class	Element 2 Element 1A	30-Question Written Examination 5-Words-Per-Minute Code Test
[1,2] Technician Class	Element 2 and 3A	55-Question Written Examination (In 2 parts-30 Element 2, 25 Element 3A) (No Morse code requirement at all)
[2] Technician Plus Class	Element 3A	25-Question Written Examination if a Novice. 5-WPM Code Test if a Technician.
General Class	Element 3B Element 1B	25-Question Written Examination 13-Words-Per-Minute Code Test
Advanced Class	Element 4A	50-Question Written Examination (No additional Morse code requirement)
Extra Class	Element 4B Element 1C	40-Question Written Examination 20-Words-Per-Minute Code Test

[1] No-Code License
[2] Effective 2/14/91

Note: Written examinations must be taken in strict ascending order of difficulty. You can't be administered Element 3A until you have passed Element 2, etc. The code tests may be taken in any order. You can take the 20-wpm code test first if you can pass it. You can enter as a Technician without code, and then gain Technician Plus CW privileges by passing the Element 1A code test. You can enter as a Novice with code, and then gain Technician Plus by passing the Element 3A theory examination.

Table 1-2. Question Element Subjects

Element 2 Novice Technician	Elementary theory and regulations
Element 3A Technician Technician Plus	Beginner-Level theory and regulations with VHF/UHF emphasis
Element 3B General	General theory and regulations with emphasis on General Class operating privileges and on HF operation
Element 4A Advanced	Intermediate theory and rules and regulations
Element 4B Extra	Specialized theory and VEC regulations

Note: All license written examinations are additive. For example, to obtain a General Class license, you must take and pass an Element 2 written examination, an Element 3A written examination and an Element 3B written examination. You may not skip over a lower class written examination.

FCC ESTABLISHES NEW CODELESS CLASS OF AMATEUR OPERATOR LICENSE (Action December 13, 1990 – PR Docket 90-55)

Effective date: February 14, 1991

The Federal Communications Commission has eased the examination requirement for the Technician Class operator license. An examinee will *not* be required to prove that he or she can send and receive texts in Morse code telegraphy signals to qualify for a Technician Class amateur operator license. There is no impact whatsoever on any amateur class except the Technician level.

The FCC noted that offering a codeless class of license that authorizes control operator privileges at stations which transmit exclusively above 30 MHz, provides an entry level opportunity to otherwise qualified persons who find telegraph a barrier to pursuing the purposes of the amateur service.

Therefore, the FCC has established on February 14, 1991, the Technician Class as the codeless class of license. This license includes *all amateur privileges* above 30 MHz at full amateur power. Group "C" (1-by-3 format) call signs are authorized where still available. The Commission also amended the rules to grandfather frequency privileges below 30 MHz to current Technician Class licensees.

The testing requirements for the code-free Technician are two examination elements: the current 30-question Element 2 and a 25-question Element 3A. A total of 55 questions in all. No new questions are being required to be added to the Element 2 and 3A question pools although some revisions of existing questions may be necessary by the Question Pool Committee.

An enhanced Technician Class operator class, informally called "Technician Plus" — for Technician plus code, will be available when a code-free Technician passes Element 1A, the 5-wpm telegraphy requirement. "Tech Plus" privileges are also available when Novice level licensees successfully complete Element 3A, the Technician written examination, at a VEC test session. Novices will not have their 5-wpm code proficiency retested at a VEC session.

Technician Plus privileges include the HF bands previously available to the Technician Class operator. They may only be vested by a three-examiner team accredited by a volunteer-examiner coordinator. This requires either Element 1A or 3A to be administered under the VEC System. The two examiner Novice testing program will not be brought under the VEC System at this time, allowing General Class operators to test for Novice, as before!

Source: FCC and W5YI

GENERAL CLASS LICENSE REQUIREMENTS

If you have no amateur operator/primary station license at all, you must first take and *pass* the written examination elements for Novice Class (Element 2) and Technician Class (Element 3A). You cannot skip over the Novice and Technician Class written examinations before you take the General written examination. You also must pass a telegraphy test at 5 words-per-minute (wpm) or higher (Element 1A, 1B, or 1C) for the Novice license. You can skip the 5-wpm Novice Class code test (Element 1A) by earning a successful passing grade at 13 wpm (Element 1B) or 20 wpm (Element 1C) on your *first* code test.

If you presently hold a valid Technician Class license, or a certificate for successful Technician Class examination completion, you will not need to retake the Technician Class examinations when you take the General Class examination.

You may take the Novice and Technician Class examinations in the same session that you take your General Class examination. Upon successful completion of Novice, Technician, and General Class examinations, all in one sitting, you will be issued a certificate of successful examination completion. However, you will not be able to go on the air until your actual FCC General Class license arrives in the mail. This usually takes about 60 days.

Technician Examinations Before March, 1987

If you passed the written Technician Class examination before March, 1987, your written requirements have been "grandfathered" and you will not need to take any further written General Class examination! The examination you took years ago covered all of the combined Technician and General Class material, and no further written examination is necessary—providing your license has not expired by more than a couple of years. Check with your local Volunteer Examination Team (VET) members—and be prepared to show them your current Technician Class license issued prior to March, 1987.

If you passed the Technician Class examination during or *after* March, 1987, you will need to take 25 more questions for the General written examination (see Chapter 3) and a 13-wpm code test (see Chapter 2).

Table 1-3 shows how the 25 questions on your General written examination are derived from the subelements of 3B. Your Novice Class written examination had 30 questions, your Technician Class had 55, and your General Class will have 25. If you upgrade to Advanced Class, it will have 50 written questions, and you will have to answer 40 questions on the examination for Extra Class.

Table 1-3. Question Distribution for the General Class Exam

Subelement		Number of Questions
3BA	Rules and Regulations (FCC rules for the amateur radio services)	4
3BB	Operating Procedures (Amateur station operating procedures)	3
3BC	Radio Wave Propagation (Radio wave propagation characteristics)	3
3BD	Amateur Radio Practices (Amateur radio practices)	5
3BE	Electrical Principles (Electrical principles as applied to amateur)	2
3BF	Circuit Components (Amateur station equipment circuit components)	1
3BG	Practical Circuits (Practical circuits employed in amateur station equipment)	1
3BH	Signals and Emissions (Signals and emissions transmitted by amateur stations)	2
3BI	Antennas and Feed Lines (Amateur station antennas and feed lines)	4
	TOTAL	25

Titles in parenthesis are the offical subelement titles listed in FCC Part 97.

GENERAL CLASS LICENSE PRIVILEGES

Let's first take a look at *Figure 1-1*, which graphically illustrates your new code and voice class privileges located on medium frequency (MF) bands (300 kHz-3 MHz) and high frequency (HF) bands (3 MHz-30 MHz). Code privileges are in the designated area on the left side of each band, and voice privileges are in the designated area on the right side of each band. Designated areas between the code and voice privileges have no privileges for the General Class; these are reserved for the Advanced and Extra Class operators.

As you can see, Advanced and Extra Class operators have the same *band* privileges that you will have as a General Class operator; they just have a little bit more elbow room. But don't worry—there is plenty of room throughout the General Class voice spectrum for working the world!

160 Meters, 1.8 MHz-2.0 MHz

Your General Class privileges are the same as Advanced and Extra on this band. You may operate voice and code from one end to the other. The 160-meter band is great for long distance nighttime communications. It's located just above the AM broadcast radio frequencies. At night, 160 meters lets you work the world.

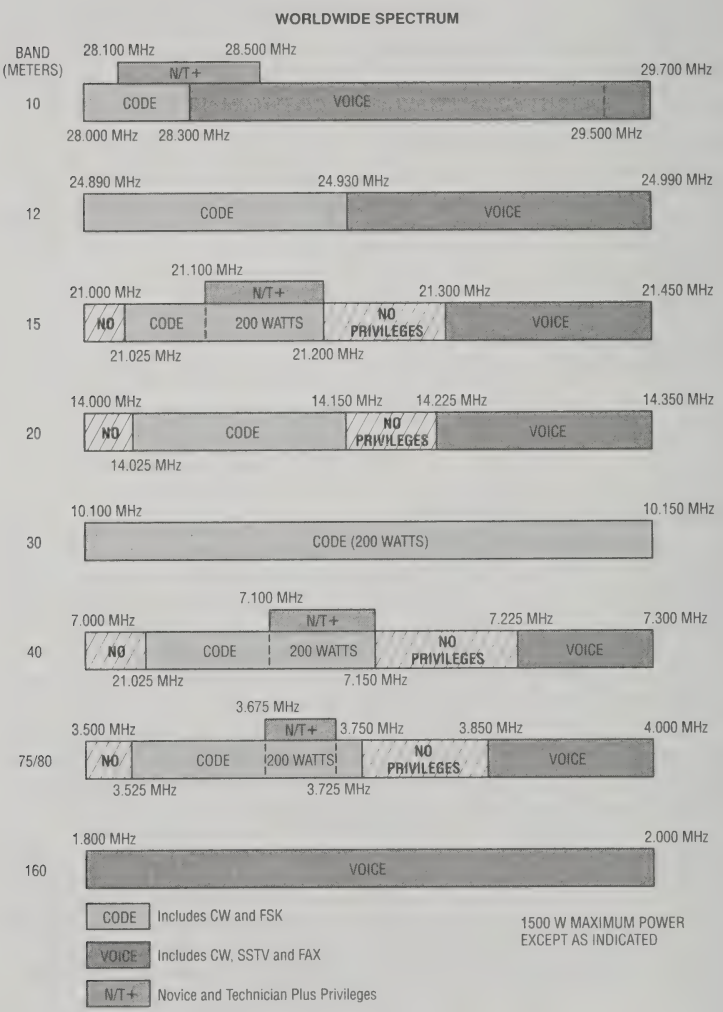


Figure 1-1. General Class RF License Privileges

80 Meters, 3.5 MHz-4.0 MHz

Your General Class code and radioteleprinter (RTTY) privileges are from 3525 kHz to 3750 kHz. Your voice single-sideband privileges are from 3850 kHz to 4000 kHz. During the day, range is limited to about 400 miles; however, at nighttime, you can work well over 3000 miles away!

40 Meters , 7 MHz-7.3 MHz

Your General Class code and radioteleprinter privileges are from 7025 kHz to 7150 kHz. Single-sideband voice for General Class is allowed from 7225 kHz to 7300 kHz. During daylight hours, 40 meters is great for base and mobile contacts up to 500 miles away. At nighttime, 40 meters is a wonderful band for worldwide DXing. However, 40 meters is also shared with worldwide AM shortwave broadcast stations, so at night, be prepared to dodge megawatt carriers playing everything from rock-and-roll to political broadcasts.

30 Meters, 10.1 MHz-10.15 MHz

Only code and radioteleprinter are permitted on this band. Thirty meters is located just above the 10 MHz WWV time broadcasts on shortwave radio. Voice is not allowed on this band by any class of amateur operator.

20 Meters, 14 MHz-14.350 MHz

This is the best DX worldwide band there is, day or night! Morse code and radioteleprinter (RTTY) privileges extend from 14.025 MHz to 14.150 MHz. Your General Class voice privileges extend from 14.225 MHz to 14.350 MHz. This is where the real DX activity takes place. Almost 24 hours a day, you should be able to work stations in excess of 5000 miles away with a modest antenna setup on the 20-meter band. If you are a mariner, most of the long range maritime mobile bands are within your privileges as a General Class operator. If you are into recreational vehicles (RV's), there are nets all over the country especially for you. The band "where it's at" is 20 meters when you want to work the world from your car, boat, RV, or home shack.

15 Meters, 21 MHz-21.450 MHz

Your General Class CW and radioteleprinter privileges extend from 21.025 MHz to 21.200 MHz. Your single-sideband voice privileges are from 21.3 MHz to 21.450 MHz. The 15-meter band is loved by hams throughout the world because it has extremely low noise. There is little power line noise on 15 meters, and there is almost no static. Band conditions on 15 meters usually favor daytime and evening contacts in the direction of the sun. Late at night, 15 meters begins to fade away, and you won't get skywave coverage until the next morning. However, when signals come in strong on 15 meters, they just about pin your S-meter. Fifteen meters is a popular band for mobile operators because antenna requirements are small. Because of the very low noise on 15

meters, you can work the world easily with just 10 watts of power (although, as a General Class operator, you are allowed up to 1500 watts of power output).

12 Meters, 24.890 MHz-24.990 MHz

The 12-meter band is a relatively new band, and not all high-frequency ham sets have capabilities for these frequencies. Your code and RTTY privileges extend from 24.890 MHz to 24.930 MHz. Your voice privileges are from 24.930 MHz to 24.990 MHz. You have the same privileges and elbow room as the Advanced and Extra Class operator, too. Although this is a very narrow band, expect excellent daytime range throughout the world. At nighttime, your range is limited to groundwave coverage because the ionosphere is not receiving sunlight to produce skywave coverage.

10 Meters, 28 MHz-29.7 MHz

Your CW and RTTY privileges begin at the very bottom of the band, 28.0 MHz, and extend up to 28.3 MHz. Your voice privileges begin immediately at 28.3 MHz, and extend to 29.7 MHz. You have the same privileges as the Advanced and Extra Class operator on 10 meters. You should already know about 10 meters since Novice and Technician Plus Class operators can operate on 10 meters using code from 28.1 MHz to 28.3 MHz and voice from 28.3 MHz to 28.5 MHz. Now you get to roam the entire band with your General Class license! But guess what—all of the activity is usually found down there in the Novice/Technician Plus Class portion of the band, 28.3 MHz to 28.5 MHz! You might even try your hand at operating frequency modulation (FM) which is permitted above 29.5 MHz. Listen for FM simplex activity at 29.6 MHz; you'll even find some 10-meter FM repeaters at the top of the band, too.

6 Meters and Up

Your General Class license allows you unlimited band privileges and unlimited emission privileges on the following bands:

Frequency	Meters
50–54 MHz	6 meters
144–148 MHz	2 meters
220–225 MHz	1.25 meters
420–450 MHz	.70 meters (70 cm)
902–928 MHz	.35 meters (35 cm)
1240–1300 MHz	.23 meters (23 cm)

Microwave Bands

Your General Class allows you unlimited band privileges and unlimited emission privileges on the following microwave bands:

Frequency	Frequency
2300–2310MHz	47.0–47.2 GHz
2390–2450 MHz	75.5–81.0 GHz
3.3–3.5 GHz	119.98–120.02 GHz
5.65–5.925 GHz	142–149 GHz
10.0–10.5 GHz	241–250 GHz
24.0–24.25 GHz	All above 300 GHz

These VHF, UHF, and SHF frequencies are the same ones for which you obtained privileges when you passed your Technician Class examination. The Novice operator has only limited privileges on the 220-MHz band and the 1270-MHz band.

For a detailed explanation of these VHF and UHF bands, refer to the *New Technician Class* authored by Gordon West. This book examines the VHF, UHF and SHF bands in detail, and presents the specific ARRL-recommended band plans.

Novice Test Administration

As a General Class operator, you may take part in the administration of a Novice examination. There are 5-wpm code tests and written examinations available commercially, or you can make up your own code tests.

You do not need to be an accredited examiner to give the simple Novice test. You and one other General Class ham may administer the Novice examination outside of the VEC system.

Even though the new no-code Technician Class license is now available, the Novice test may still be administered by two non-VE accredited examiners for both code and theory examinations.

General Class operators will *not* be able to certify a 5-wpm code examination *after* an applicant chooses the no-code route to become a ham radio operator.

SUMMARY

So there you have it—a look at some of the exciting privileges awaiting you with a General Class license. Undoubtedly the biggest privilege is gaining voice access to every worldwide band allocated to the amateur service. These new world-wide band privileges, coupled with all modes of operation plus 1500 watts of power output, will certainly give you some DX excitement as you talk to the world.

FCC RELOCATES NOVICE AND TECHNICIAN PLUS PRIVILEGES IN THE 80-METER WAVELENGTH BAND (PR Docket 90-100)

The Federal Communications Commission has amended its rules to relocate Novice and Technician Plus Operator Class control operator frequency privileges in the 80-meter amateur service band from the 50-kHz segment at 3700-3750 kHz to the segment at 3675-3725 kHz. This rule change will reduce the amount of mutual interference between United States amateur stations and Canadian amateur stations, and provide Novice and Technician Plus Class control operators with more opportunities to improve their telegraphy skills.

Commission rules authorize amateur stations with a control operator holding a Novice or Technician Plus Class operator license to transmit telegraphy in the 80-meters Novice segment. This segment is designed so that beginning amateur radiotelegraphers can gain actual experience in sending and receiving telegraphy messages. In Canada, however, frequencies in the upper half of the 80-meters Novice segment are used by amateur stations for telephony transmission, thus creating the potential for interference when a U.S. station transmits telegraphy on the same channel and at the same time as the Canadian station. Relocation of the 80-meters Novice segment to 3675-3725 kHz provides a solution to the mutual interference problem.

Source: FCC

FCC MAKES AMATEUR SERVICE MORE ACCESSIBLE TO HANDICAPPED OPERATORS (PR Docket 90-356)

The Federal Communications Commission has amended its rules to make the amateur service more accessible to amateur operator licensees who, because of "severe handicaps," are incapable of passing the higher-speed Morse code telegraphy examinations.

On August 1, 1990, the FCC proposed exempting from the 13- and 20-wpm telegraphy examinations amateur operator licensees who are incapable of passing those examinations due to severe handicaps. Because of international requirements, however, no exemptions would be granted from the 5-wpm telegraphy examination.

The rules adopted require a physician's certification and a release permitting disclosure to the FCC of medical information pertaining to the handicap. The Commission said that the term "physician" would be limited to practitioners with full medical privileges, that is, doctors of osteopathy or doctors of medicine.

Source: FCC

2

Building CW Speed to 13 WPM

GENERAL CLASS CODE TEST REQUIREMENTS

The code test requirement for the United States amateur service General Class operator's license is 13 wpm. This requirement is about in the middle of what other countries may require for their worldwide privileges. Some countries, such as France, have only a 10-wpm requirement for worldwide operating privileges. Other countries, such as Napal, require their worldwide candidates to pass a 28-wpm Morse code test. The United States' 13-wpm General Class code test is one of the easiest code examinations to pass. This is due largely to our new volunteer examination system which is explained in Chapter 4.

Test Administration

The General Class amateur operator's code test is administered by a team of three Volunteer Examiners (VEs) accredited by a Volunteer-Examiner Coordinator (VEC). These VEs may make up their own code test, or they may use a code test supplied on cassette tape from a VEC. Regardless of who makes up the code test, the CW portion of your General class examination is fairly well standardized throughout the country.

Test Speed

Federal Communications Commission amateur operator's code test recommendations (Notice, dated June 22, 1982) call for the 13-wpm code test to be generated at approximately 14-1/2-wpm character speed, with spaces in between each character to yield a 13-wpm rate. In other words, you shouldn't expect your code test to be generated at 25-wpm character speed, with big spaces to slow the entire message down to 13 wpm. The recommended code tone is 1000 hertz, plus or minus 10 percent.

The American Radio Relay League generates their code examinations for General Class at an 18-wpm character rate, spaced to 13 wpm. The ARRL examinations are characterized by slightly shorter and more compact dits and dahs, with slightly longer spaces between each element. Our code tapes reflect this slightly faster Farnsworth rate, and should prove helpful in preparing you for almost any type of VEC General Class code test. You can hear this slightly faster Farnsworth rate by tuning into the ARRL code practice frequencies, listed on Page 16.

The cassettes that accompany this book have been developed to give you the closest thing to the absolute FCC code test recommendations that you can find. Ideally, the code test you take will sound exactly like the sample code test on the second cassette tape. In many cases, VEs and VECs use such materials for the code tests because they know that many hams use them for preparation.

When to Take the Test

The General Class code test, Element 1B, may be taken anytime you feel ready. In fact, you may take a code test for Extra, General, or Novice anytime regardless of your advancement through the written examinations. However, you can't go on the air as a General Class operator until you have passed the General Class written examination and its prerequisites (Element 2 and 3A) plus the 13-wpm code test.

If you wake up one morning and feel very confident that you can pass the code test, take it. If you pass the test, you receive a one-year certificate for the code completion; that gives you 365 days to pass the written examination and complete the total requirements. If you have code experience and have sharpened your skills, you might want to go ahead and take instead the 20-wpm code test which is required for the Extra Class license. Passing it would give you two steps in one (General and Extra) because it also gives you complete credit for the General 13-wpm test. If you did go ahead and pass the 20-wpm code test, satisfying the code portion of your Extra Class operator's license, you have one year to complete the Advanced and Extra Class written examinations.

THE TEST MESSAGE AND QUESTIONS

Your General Class code test will last 5 minutes. It will be preceded by a 1-1/2 minute warmup that lets you adjust to the acoustics of the room. Some VETs supply headphones; others use a professional tape recorder and speaker system to reproduce the code message.

The 5-minute code test at 13 wpm most likely will be a "QSO" type message. It will be as if you tuned in to one amateur operator communicating with another. You copy the message as best you can, and then answer questions, usually 10, about the message.

If you answer 7 out of 10 questions correctly, you pass the code test portion of your General Class examination. You are not required to send any code for the examination—just receive.

Sometimes your VEs will give you a 10-question test with multiple-choice answers. This is the easiest way to go for General! Other VEs may give you a 10-question test that requires you to fill in the blanks. This is a little bit tougher. You should check with your VET ahead of time to see whether or not they ask for fill-in-the-blank or multiple-choice answers to the QSO test.

VEs usually allow ample time after the test for you to correct your code copy, and then turn in one minute of perfect copy that agrees with the message that was sent. However, because this is probably the hardest way to get through the code test, most VETs have the written code test option in addition to one minute of solid copy.

Typical Message

Warmup

Here is a sample 13-wpm QSO that could be used on a General Class code test: (See Appendix for additional typical QSOs)

> This is a 1 minute warmup for the adjustment of the tape player equipment. Good luck on the test.

Actual Exam Message

After the warm-up message, a spoken announcement tells you that the test is about to begin.

> VVVVVV N7TVK DE KA0DHO.
> Tnx James. UR RST 489--489.
> I am mobile in Colorado on my way to vacation at Disneyland in California. Name is Brian. Rig is a 200 watt Icom and antenna is a 10 meter whip. I am 36 years old and my wife and kids are all General Class hams. Occupation is a lawyer. The WX is freezing/ cold and the temperature is 25 degrees. Must QRT to stop for some lunch. How Copy? N7TVK DE KAØDHO $\overline{AR}$ $\overline{SK}$

The General Class code test usually begins with a series of six Vs, then goes right into call signs. Call signs are sometimes hard to copy, but since they are often repeated at the end, you have two chances to copy them. Try exceptionally hard to get those call letters. Seldom does an examiner put in misspellings or deceptive QSOs (such as a weather report of 100 degrees in Alaska).

If you look carefully at the message, you will find that it contains all letters of the alphabet, numerials 0-9, period, comma, question mark, sign-off signals $\overline{AR}$ and $\overline{SK}$, the break or pause $\overline{BT}$, and the slant bar $\overline{DN}$. This requirement is spelled out in FCC Section 97.21(3)(b). New proposed rules to delay code test requirements may drop this "every letter" requirement! Code tests soon will be easier.

Typical Questions

The following are typical questions your VET would ask after you have copied the coded QSO message:

1. What was the call sign of the sending operator? (KAØDHO)
2. What was the name of the receiving operator? (James)
3. What was the RST report given? ((489)
4. What was the QTH of the sending operator? (Colorado)
5. What type of transceiver was the sending operator using? (Icom)
6. What type of antenna was the sending operator using? (Whip)
7. What was the power output in watts of the sending. operator's rig? (200)
8. What were the weather conditions at the sending operator's. location? (Freezing/Cold)
9. What was the occupation of the sending operator? (Lawyer)
10. Why did the sending operator go QRT? (To stop for some lunch)

After Copying the Code

Even if you didn't copy the code 100 percent, letter-for-letter, you should still be able to extract enough information to correctly answer 10 questions similar to the above. If the answers are multiple-choice, all the better!

If you determine that you did just great for about a minute during the middle of the message, but goofed up at the beginning and end, you may want to try for the one minute of solid copy. *You will usually have time after the examination to correct your copy, regardless of what type of message is sent.*

Second Chance

It's not at all uncommon to "freeze up" during the actual code test. The training cassette tapes that accompany this course give you pointers on how to stay calm during the real thing. However, if you should "bomb" the test the first time through, ask your examination team if they will allow you to take another test a few minutes later. If so, they will require you to pay a second test fee, and, of course, the second test message will be different from the first one. Many times, a person passes that big 13-wpm code test on the second try.

CODE TAPES

The code cassette tapes that accompany this course start out at 5 wpm with a character speed of 14-1/2 wpm and long spaces. This lets you hear the exact dit-dah ratio that will ultimately be on your General Class test. As the overall wpm rate is increased, the space between each code character is reduced while the character speed remains the same. At the end of the cassette course, you will be listening to sample code tests generated slightly faster than the actual 13-wpm General Class test. This gives you a little edge because you are over-prepared for the actual test. *Table 2-1* lists the tapes and their contents.

Table 2-1. Code Tape Contents

Tape No.	Side	Contents
1	A	Introduction and Morse Code review at 5 wpm (characters generated at 14 1/2 wpm).
1	B	Code speed building — 6 wpm to 10 wpm.
2	A	Code speed building — 10 wpm to 13 wpm.
2	B	Code test preparation — 13, 14 and 15 wpm.

The author recorded these code tapes, and had some real laughs in the process! You should too.

Tape Player

The code tapes will play on any audio cassette tape player. Keep your equipment clean and give the tape heads a polish now and then with tape recorder head cleaner (available at Radio Shack stores). Let the heads and pinch rollers

completely dry before inserting a tape. Dirty heads or pinch rollers sometimes "eat" your tape. If this occurs, carefully pull the tape out of the mechanism, and then carefully wind the loose tape back into the cassette. A pencil is a good tool to turn the cassette take-up reel.

You will find the code training tapes humorous and fun to listen to, as well as educational. You may think that you're beginning to memorize words and phrases on the test preparation tapes. That's what we want you to do! We will have you memorize those common words found in most ham radio communications. You will soon learn that beverage is also an antenna, not a soft drink! You will learn how to anticipate where certain characters may be used. For example, you will find that the slant bar ($\overline{DN}$) usually is used between the weather reports (cold/windy). The pause, or break ($\overline{BT}$), may be used between RST reports (589 $\overline{BT}$ 589)

How to Use the Tapes

The code cassette speed building tapes are fully narrated and may be played almost anywhere. The best practice is to write down the code, rather than just listening and memorizing it. Always practice copying the code to paper.

Copy for 20-Minute Segments

Start a notebook at 5 wpm, and keep track of your progress listening to these cassette tapes. Play the code tapes for only about 20 minutes, and then take a break for several hours. It's far better to study for 20 minutes three times a day, than it is to go for a 1-1/2 hour marathon brain-out.

Listen Carefully: Listen carefully to the daily instructions on the code cassettes. Every lesson is under 20 minutes, and this makes for perfect practice two or three times a day.

Try to Go Faster: Continually push yourself to go on to a faster rate on the code tapes. Once you have mastered a code segment so you can copy 75 percent correctly, push on. Don't try to get 100 percent perfect copy—few ham radio operators copy code perfectly.

Don't Read As You Copy: Don't try to read the message as you are copying it—put your hand over it, and keep your eyes on your pen or pencil as you write the next letter. Don't anticipate or try to second guess what's coming next! After the code test is over, you will have plenty of time to go back and correct your copy.

Missing Characters: If you miss a letter or number, put a little "peck" mark on your paper and catch the very next letter. Chances are you can easily figure out the missing letter later by looking at the entire word. However, if you try to determine that letter during the actual code test, chances are you're going to miss the next few letters, or maybe words. Copy letter for letter, and don't let a missed letter throw you!

LISTEN TO OTHER SOURCES

For the code tapes to be effective, we recommend you listen to Morse code from other sources, as well. *Table 2-2* lists many frequencies where you can copy CW

sent between 5 wpm and 15 wpm. On-the-air code practice is an excellent way to increase code speed. If you have a high frequency transceiver with a Novice or Technician Plus Class license, you have four worldwide bands that you can go on the air using Morse code right now. Don't miss this valuable opportunity to increase your code proficiency.

Table 2-2. Radio Frequencies for Code Reception

MTWThFSSn = Days of Week Dy = Daily
W1AW code practice and bulletin transmissions are sent on the following schedule:

EST	Slow Code Practice	MWF: 9 AM, 7 PM; TThSSn: 4 PM, 10 PM
	Fast Code Practice	MWF: 4 PM, 10 PM; TTh: 9AM; TThSSn: 7 PM
	CW Bulletins	Dy: 5 PM, 8 PM, 11 PM; MTWThF: 10AM
CST	Slow Code Practice	MWF: 8 AM, 6 PM; TThSSn: 3 PM, 9 PM
	Fast Code Practice	MWF: 3 PM, 9 PM; TTh: 8 AM; TThSSn: 5 PM
	CW Bulletins	Dy: 4 PM, 7 PM, 10 PM; MTWThF: 9 AM
MST	Slow Code Practice	MWF: 7 AM, 5 PM; TThSSn: 2 PM, 8 PM
	Fast Code Practice	MWF: 2 PM, 8 PM; TTh: 7 AM; TThSSn: 5 PM
	CW Bulletins	Dy: 3 PM, 6 PM, 9 PM; MTWThF: 8 AM
PST	Slow Code Practice	MWF: 6 AM, 4 PM; TThSSn: 1 PM; 7 PM
	Fast Code Practice	MWF: 1 PM, 7 PM; TTh: 6 AM: TThSSn: 4 PM
	CW Bulletins	Dy: 2 PM, 5 PM, 8 PM; MTWThF: 7 AM

- Code practice, Qualifying Run and CW bulletin frequencies: 1.818, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 147.555 MHz.
- Slow code practice is at 5, 7½, 10, 13 and 15 WPM. Fast code practice is at 35, 30, 25, 20, 15, 13, and 10 wpm.
- CW bulletins are sent at 18 wpm.
- Code practice texts are from *QST*, and the source of each practice is given at the beginning of each practice and at the beginning of alternate speeds. For example, "Text is from September 1990 *QST*, pages 16 and 79" indicates that the main text is from the article on page 16 and the mixed number/letter groups at the end of each speed are from the contest scores on page 79.
- Some of the slow practice sessions are sent with each line of text from *QST* reversed. For example, "Last October, the ARRL Board of Directors" would be sent as DIRECTORS OF BOARD ARRL THE, OCTOBER LAST.

Practice, Practice, Practice

Listen to any type of code that you think you have a chance of copying. Don't worry about code that doesn't sound exactly like our test preparation tapes—any code will do. With almost any type of shortwave radio receiver, you can pick up hundreds of code broadcasts. Also, there are many code cassettes on the market; and as long as you can make out the dits and dahs, it's good practice.

Let a Friend Send You Code

Let a fellow ham send you some code on a practice keyer. If he or she doesn't have a keyer, he or she can send you code over the telephone by pushing one of the number keys as if it were a telegraph key!

SUMMARY

Morse code is fun; and when you pass your General class code test, you will join the ranks of approximately 115,000 Amateur Radio General Class operators who spent a little time and effort in mastering the code at 13 wpm for their new General Class worldwide privileges.

3

Getting Ready for the Written Examination

ABOUT THIS CHAPTER

This chapter covers all the possible exact questions and answers that you will have on your General Class Element 3B written examination. Your examination will have 25 questions selected from the total of 286 questions which are divided into nine element categories as shown in *Table 3-1*. Each category has a specific number of possible questions and a specific number of actual questions that will be on the test. Carefully study *Table 3-1* so you will understand how the possible and actual questions are distributed among the nine categories.

Table 3-1. Question Pool

Subelement		Page	Total Questions	Examination Questions
3BA	Rules and Regulations	18	46	4
3BB	Operating Procedures	30	35	3
3BC	Radio-Wave Propagation	39	30	3
3BD	Amateur Radio Practices	46	50	5
3BE	Electrical Principles	61	41	2
3BF	Circuit Components	72	11	1
3BG	Practical Circuits	75	10	1
3BH	Signals and Emissions	77	22	2
3BI	Antennas and Feed Lines	82	41	4
TOTAL			286	25

Your examination will have exactly 25 questions and 4 multiple-choice answers per question. You must answer 74 percent of the questions correctly, which means that you must answer 19 questions correctly.

Your 25 questions will be selected word-for-word from the 286 question pool contained in this chapter. Each question has four possible multiple-choice answers. The correct answer to each question is given along with a discussion on why the correct answer is indeed the right one.

WHAT THE EXAM CONTAINS

The examination questions of all license class levels and their appropriate multiple-choice distractors are public information. They are widely published in books similar to this one by various license preparation materials publishers. FCC rules prohibit any examiner or examination team from making any changes to any questions, including any numerical values! No numbers, words,

letters, or punctuation marks may be altered from the published question pool. Thus, the questions in this book are exactly as they will appear on your examination. In addition, the same four multiple-choice answers will most likely be worded on the test exactly as they are published here; however, their A, B, C, D, order may be changed.

All amateur operator examination questions are reviewed every three years by a team of volunteer-examiner coordinators (VECs). These are fellow hams with Extra Class licenses that volunteer their time to insure today's tests are accurate and fair, and the subject matter relevant. As technology changes, so will the questions. A public notice will be given one year in advance for any question changes so book publishers can revise their study materials. The new questions will be widely distributed so that a person wanting to obtain an amateur operator's license will have current information.

QUESTION POOL AND PART 97 UPDATES

The 286 General question pool has an effective date of November 1, 1990. It will probably not change for at least three additional years, after that date. And if there are any new changes, the changes will be extremely minor. The most recent changes have been the plain language wording of emission designators. Older General books may say "J3E", but the new wording is now"single sideband." There will be widespread publicity before any new changes to the General Class question pool.

Question Coding

Each question of the 286 General Class question pool is coded according to the numbers and letters assigned to those questions. *Figure 3-1* explains the coding for question 3BB-4.1.

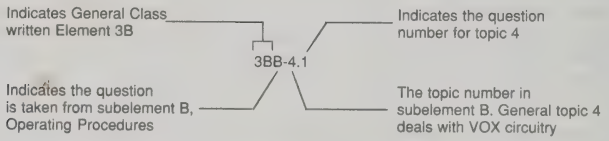


Figure 3-1. Examination Question Coding

The coded numbers and letters reveal important facts about each question. Each subelement has a number of topics within it. Each topic is numbered, and the questions in each topic are numbered. Therefore, 3BB-4.1 indicates the question is an Element 3B (General Class) question from subelement B (Operating Procedures). It is the first (0.1) question from topic number 4 (VOX circuitry).

You probably are saying, "286 questions sounds like an impossible memory job." Good news—almost every question is asked twice with some slightly different phraseology. This means you only have to memorize about 125 questions asked a couple different ways. You can do that easily—right?

EXAMINATION QUESTIONS

Go ahead, now, and scan through the examination questions. Note the subelements we talked about. Note also that the number of examination questions to be taken from the subelement is given. This corresponds to the numbers in *Table 3-1* for the subelement. Notice that the question coding, which we explained above, indicates when the subelements and topics change. Gaps in the question numbers are a result of the removal of the Technician Class questions several years ago to split the Technician and General Class written question pool.

HINTS ON STUDYING FOR THE EXAM

All of the material that you need to study for your General Class examination is in this chapter, organized and combined in a convenient format. Here are some suggestions to make your learning easier:

1. Begin with the first subelement, 3BA. Study the question, the correct answer, and the brief description that we have given to better understand the importance of the question and why the answer is correct. It's also a good idea to look at the incorrect answers for some additional pointers on why the correct answer is indeed the right one. Put a check mark beside each question you know perfectly.
2. Be sure to read over each multiple-choice answer carefully. Some start out looking good, but just one or two words may change the answer from right to wrong. Also, don't anticipate that the multiple-choice answers will always appear in exactly the same A, B, C, D order on your General Class exam; some examiners may change the order.
3. Keep in mind how many questions may be taken out of any one subelement. For instance, although there are 10 total questions in subelement 3BG, Practical Circuits, only one question will be selected for your examination from this entire short subelement.
4. A fun way of preparing for the exam is to let someone else read the correct answer, and you try to recite the exact General Class question!
5. Once you have memorized most of the questions and correct answers, put a check mark beside those you know forward and backward. Then concentrate on the remaining harder questions that may require better understanding and more memorization. Put a check mark beside them as you have them completely memorized.
6. Try a practice written exam and see how well you do. Ask a friend to give you a sample test by picking a series of questions according to the distribution shown in *Table 3-1*.
7. On those particularly hard questions, make up flash cards with the question on one side and the four possible answers on the reverse side. See if you can pick out the right answer.

WRITTEN EXAMINATION QUESTION POOL

So here you go—286 questions, many almost duplicates of themselves but changed in wording—for your General Class written test preparation.

Subelement 3BA – Rules and Regulations (4 examination questions from 46 questions in 3BA))

3BA-3.2 What is the maximum transmitting power permitted an amateur station on 10.14 MHz?

A. 200 watts PEP output
B. 1000 watts dc input
C. 1500 watts PEP output
D. 2000 watts dc input

ANSWER A: The 30-meter, 10-MHz band is relatively new to the amateur service. Only code and frequency shift keying is allowed. Also, only 200 watts output of power is allowed. (See *Figure 1-1*)

3BA-3.3 What is the maximum transmitting power permitted an amateur station on 3725 kHz?

A. 200 watts PEP output
B. 1000 watts dc input
C. 1500 watts PEP output
D. 2000 watts dc input

ANSWER A: 3725 kHz is in the middle of the Novice sub-band on 75 meters. Everyone, including higher class licensees, must keep their power below 200 watts peak envelope power output in this 75 Novice sub-band. (See *Figure 1-1*)

3BA-3.4 What is the maximum transmitting power permitted an amateur station on 7080 kHz?

A. 200 watts PEP output
B. 1000 watts dc input
C. 1500 watts PEP output
D. 2000 watts dc input

ANSWER C: Is 7080 kHz in the Novice sub-band? No, just below it—so General Class operators and higher may run up to 1500 watts PEP output. (See *Figure 1-1*)

3BA-3.5 What is the maximum transmitting power permitted an amateur station on 24.95 MHz?

A. 200 watts PEP output
B. 1000 watts dc input
C. 1500 watts PEP output
D. 2000 watts dc input

ANSWER C: 24.95 MHz is in the 12-meter band, and there are no Novice sub-bands nor power restrictions on 12 meters. This is why hams may run the maximum allowable power output, 1500 watts PEP output. (See *Figure 1-1*)

3BA-3.7 What is the maximum transmitting power permitted an amateur station transmitting on 21.150 MHz?

A. 200 watts PEP output
B. 1000 watts dc input
C. 1500 watts dc input
D. 1500 watts PEP output

ANSWER A: 21.150 MHz is right in the middle of the Novice sub-band for 15 meters.

Everyone may run no more than 200 watts PEP output because it's a Novice sub-band. (See *Figure 1-1*)

3BA-4.1 How must a General control operator at a Novice station make the station identification when transmitting on 7250 kHz in ITU Region 2?

A. The control operator should identify the station with his or her call, followed by the word "controlling" and the Novice call.
B. The control operator should identify the station with his or her call, followed by the slant bar "/" (or any suitable word) and the Novice call.
C. The control operator should identify the station with the Novice call, followed by the slant bar "/" (or any suitable word) and his or her own call.
D. A Novice station should not be operated on 7050 kHz, even with a General Class control operator.

ANSWER C: The General operator is visiting a Novice Class operator's station. They both go on the air. Since they are outside the band privileges for Novice, the General Class operator is the control operator, and the General Class operator uses his or her call sign after the Novice call with a slant bar in the middle. Just remember the General Class call sign always appears at the end when operating outside of the Novice sub-band with a Novice at the mike and the General as a control operator.

3BA-4.3 How must a control operator who has a Technician Class license and a "Certificate of Successful Completion of Examination" for General Class privileges identify the station when transmitting on 14.325 MHz? [assume telephony]

A. General-class privileges do not include 14.325 MHz.
B. No special form of identification is needed.
C. The operator shall give his or her call sign, followed by "slant mark" or any suitable word that denotes the slant mark and the identifier "AG"
D. The operator shall give his/her call sign, followed by the date and location of the VEC examination where he/she obtained the upgraded license.

ANSWER C: You may go on the air immediately when you pass your upgrade. Your examination team will give you a certificate of successful completion. Use the letters "AG" after the word "temporary" when you upgrade to General before your new license arrives from the FCC.

3BA-6.1 Under what circumstances, if any, may third-party communications be transmitted to a foreign country by an amateur station where the third party is not eligible to be a control operator of the station?

A. Under no circumstances
B. Only if the country has a third-party traffic agreement with the United States
C. Only if the control operator is an amateur Extra Class licensee
D. Only if the country has formal diplomatic relations with the United States

ANSWER B: The United States has few third-party agreements with European countries. Most of our third-party agreements are with South America. Never pass traffic on behalf of someone else to a foreign country until you have checked the third-party agreement list.

V2	Antigua & Barbuda	YS	El Salvador	ZP	Paraguay
LU	Argentina	C5	The Gambia	OA	Peru
VK	Australia	9G	Ghana	VR6	Pitcairn Island*
V3	Belize	J3	Grenada	V4	St Christopher (St. Kitts) and Nevis
CP	Bolivia	TG	Guatemala		
PY	Brazil	8R	Guyana	J6	St. Lucia
VE	Canada	HH	Haiti	J8	St. Vincent
CE	Chile	HR	Honduras	3D6	Swaziland
HK	Colombia	4X	Israel	9Y	Trinidad & Tobago
TI	Costa Rica	6Y	Jamaica	GB	United Kingdom**
CO	Cuba	JY	Jordan	CX	Uruguay
J7	Dominica	EL	Liberia	YV	Venezuela
HI	Dominican Rep.	XE	Mexico	4U1ITU	ITU, Geneva
HC	Ecuador	YN	Nicaragua	4U1VIC	VIC, Geneva
		HP	Panama		

* Informal Temporary

** Limited to special-event stations with callsign prefix GB; GB3 excluded

List of Countries Permitting Third-Party Traffic

3BA-6.2 What types of messages may be transmitted by an amateur station to a foreign country for a third-party?

A. Third-party communications involving material compensation, either tangible or intangible, direct or indirect, to a third party, a station licensee, a control operator, or other person

B. Third-party communications facilitating the business affairs of any party

C. Third-party communications limited to messages of a technical nature or remarks of a personal character

D. No messages may be transmitted to foreign countries for third parties

ANSWER C: If the United States has a third-party agreement, and you are letting someone else talk over the mike to a Latin American country, make sure they stay within the third-party traffic rules—no business communications, and the messages must be strictly personal and by reason of their unimportance do not require a phone call to that country.

3BA-6.6 Which of the following limitations apply to third-party messages transmitted to foreign countries where the third party is not eligible to be a control operator of the station?

A. Third-party messages may only be transmitted to amateurs in countries with which the US has a third-party traffic agreement.

B. Third-party messages may only be sent to amateurs in ITU Region 1.

C. Third-party messages may only be sent to amateurs in ITU Region 3.

D. Third-party messages must always be transmitted in English.

ANSWER A: Although hams may talk with every foreign country in the world, they must limit their communications so they are only between the two ham stations, and not permit any third-party messages to take part in their transmissions unless the United States specifically has a third-party agreement with that foreign country.

3BA-8.6 Under what circumstances, if any, may an amateur station transmitting on 29.64 MHz repeat the 146.34-MHz signals of an amateur station with a Technician control operator?

A. Under no circumstances
B. Only if the station on 29.64 MHz is operating under a Special Temporary Authorization allowing such retransmission
C. Only during an FCC-declared general state of communications emergency
D. Only if the control operator of the repeater transmitter is authorized to operate on 29.64 MHz

ANSWER D: 29.64 MHz requires a General Class license or higher. While it's okay to retransmit signals from the 2-meter band onto 29.64, you as the control operator at 29.64 must have a General Class license or higher for this band. "Crossband DXing" can be a real thrill for a Novice or Technician Class operator to get a taste of worldwide frequencies with a General Class control operator handling the link.

3BA-9.1 What frequency privileges are authorized to General operators in the 160-meter band?

A. 1800 to 1900 kHz only
B. 1900 to 2000 kHz only
C. 1800 to 2000 kHz only
D. 1825 to 2000 kHz only

ANSWER C: *Figure 1-1* shows the RF privileges for General Class licensees. You will need to look at the frequency chart in the Appendix to better visualize all the privileges for the General, Advanced, and Extra Class operators. On 160 meters, General, as well as Advanced and Extra Class, have full privileges from the bottom of the band to the top.

3BA-9.2 What frequency privileges are authorized to General operators in the 75/80-meter band?

A. 3525 to 3750 and 3850 to 4000 kHz only
B. 3525 to 3775 and 3875 to 4000 kHz only
C. 3525 to 3750 and 3875 to 4000 kHz only
D. 3525 to 3775 and 3850 to 4000 kHz only

ANSWER A: Your General CW privileges begin 25 kHz above the band edge—3525 to 3750 kHz. Your General voice privileges then start at 3850 kHz to 4000 kHz. The area in between the CW and voice portion of this band is reserved for higher class operators. (See *Figure 1-1*)

3BA-9.3 What frequency privileges are authorized to General operators in the 40-meter band?

A. 7025 to 7175 and 7200 to 7300 kHz only
B. 7025 to 7175 and 7225 to 7300 kHz only
C. 7025 to 7150 and 7200 to 7300 kHz only
D. 7025 to 7150 and 7225 to 7300 kHz only

ANSWER D: Once again, CW privileges begin 25 kHz above the bottom of the band edge 7025 kHz and extend to 7150 kHz. From 7150 kHz to 7225 kHz there are no privileges, but at 7225 kHz, voice extends to the band edge. Memorize these frequency limits. (See *Figure 1-1*)

3BA-9.4 What frequency privileges are authorized to General operators in the 30-meter band?

A. 10,100 to 10,150 kHz only
B. 10,105 to 10,150 kHz only

C. 10,125 to 10,150 kHz only
D. 10,100 to 10,125 kHz only

ANSWER A: Generals now get the entire 30-meter band from 10.1 to 10.15 MHz—200 watts of power maximum and CW/FSK privileges only—no voice. (See *Figure 1-1*)

3BA-9.5 What frequency privileges are authorized to General operators in the 20-meter band?

A. 14,025 to 14,100 and 14,175 to 14,350 kHz only
B. 14,025 to 14,150 and 14,225 to 14,350 kHz only
C. 14,025 to 14,125 and 14,200 to 14,350 kHz only
D. 14,025 to 14,175 and 14,250 to 14,350 kHz only

ANSWER B: This is the big band for DX, 24 hours a day. Your code privileges begin 25 kHz above the bottom of the band at 14.025 MHz, and then have a break at 14.150 MHz for a band of no privileges to 14.225 MHz. Voice privileges extend from 14.225 MHz to 14.350 MHz. Read over the correct answer to memorize these frequency limits for your General Class license. (See *Figure 1-1*)

3BA-9.6 What frequency privileges are authorized to General operators in the 15-meter band?

A. 21,025 to 21,200 and 21,275 to 21,450 kHz only
B. 21,025 to 21,150 and 21,300 to 21,450 kHz only
C. 21,025 to 21,200 and 21,300 to 21,450 kHz only
D. 21,000 to 21,150 and 21,275 to 21,450 kHz only

ANSWER C: 15 meters is a great DX band. Like 20 meters, there is a no privileges band from 21.2 MHz to 21.3 MHz. On one side there is CW, and on the other side is voice. Your General Class CW privileges begin 25 kHz above the band edge and extend to 21.2 MHz. Voice privileges start at 21.3 MHz and extend to 21.450 MHz. Memorize these frequencies for General Class privileges. (See *Figure 1-1*)

3BA-9.7 What frequency privileges are authorized to General operators in the 12-meter band?

A. 24,890 to 24,990 kHz only
B. 24,890 to 24,975 kHz only
C. 24,900 to 24,990 kHz only
D. 24,790 to 24,990 kHz only

ANSWER A: You get the entire 12-meter band as a General—from top to bottom, 24.890 to 24.990 MHz! 24.930 is the separation between the code and voice portion of the band. Maximum power output is permitted. (See *Figure 1-1*)

3BA-9.8 What frequency privileges are authorized to General operators in the 10-meter band?

A. 28,000 to 29,700 kHz only
B. 28,025 to 29,700 kHz only
C. 28,100 to 29,700 kHz only
D. 28,025 to 29,600 kHz only

ANSWER A: You know all about the 10-meter band; and as a General, you gain full band privileges all the way from the very bottom of the band to the very top of the band, 28.0 to 29.7 MHz. Voice activity begins at 28.3 MHz through 29.7 MHz.

3BA-9.9 Which operator licenses authorize privileges on 1820 kHz?

A. Extra only
B. Extra, Advanced only
C. Extra, Advanced, General only
D. Extra, Advanced, General, Technician only

ANSWER C: Refer to chart in Appendix. Are there Novice privileges on 1820 kHz? No! This is why the Novice and Technician do not have access to this band, so Answer C is correct.

3BA-9.10 Which operator licenses authorize privileges on 3950 kHz?

A. Extra, Advanced only
B. Extra, Advanced, General only
C. Extra, Advanced, General, Technician only
D. Extra, Advanced, General, Technician, Novice only

ANSWER B: Refer to chart in Appendix. Is this a Novice sub-band? No! No Novice or Technician class operators on this frequency.

3BA-9.11 Which operator licenses authorize privileges on 7230 kHz?

A. Extra only
B. Extra, Advanced only
C. Extra, Advanced, General only
D. Extra, Advanced, General, Technician only

ANSWER C: Refer to chart in Appendix. Is this a Novice sub-band? No! Again, no Novice or Technician Class privileges.

3BA-9.12 Which operator licenses authorize privileges on 10.125 MHz?

A. Extra, Advanced, General only
B. Extra, Advanced only
C. Extra only
D. Technician only

ANSWER A: Refer to chart in Appendix. Is this a Novice sub-band? No! No Novice or Technician Class privileges.

3BA-9.13 Which operator licenses authorize privileges on 14.325 MHz?

A. Extra, Advanced, General, Technician only
B. Extra, Advanced, General only
C. Extra, Advanced only
D. Extra only

ANSWER B: Refer to chart in Appendix. Is this a Novice sub-band? No! So Novices and Technicians may not use it.

3BA-9.14 Which operator licenses authorize privileges on 21.425 MHz?

A. Extra, Advanced, General, Novice only
B. Extra, Advanced, General, Technician only
C. Extra, Advanced, General only
D. Extra, Advanced only

ANSWER C: Refer to chart in Appendix. Is this a Novice sub-band? No! Again, no Novice or Technician Class privileges.

3BA-9.15 Which operator licenses authorize privileges on 24.895 MHz?

A. Extra only
B. Extra, Advanced only
C. Extra, Advanced, General only
D. None

ANSWER C: Refer to chart in Appendix. Is this a Novice sub-band? No, not even any Technicians! As a result, only Extra, Advanced, and General operators may use this band.

3BA-9.16 Which operator licenses authorize privileges on 29.616 MHz?

A. Novice, Technician, General, Advanced, Extra only
B. Technician, General, Advanced, Extra only
C. General, Advanced, Extra only
D. Advanced, Extra only

ANSWER C: Refer to chart in Appendix. Is this a Novice sub-band? No! No Technician Class either.

3BA-10.1 On what frequencies within the 160-meter wavelength band may phone emissions be transmitted?

A. 1800-2000 kHz only
B. 1800-1900 kHz only
C. 1900-2000 kHz only
D. 1825-1950 kHz only

ANSWER A: There is no CW-only sub-band on 160 meters. This allows phone voice operation throughout the band.

First Character	Second Character	Third Character
N Emission of an unmodulated carrier	Ø No modulating symbol	N No information transmitted
A AM double-sideband	1 Digital information – no modulation	A Telegraphy for reception by air
J Single sideband, suppressed carrier	2 Digital information with modulation	B Telegraphy for automatic reception
F Frequency modulation	3 Modulated with analog information	C Facsimile
P Sequence of unmodulated pulses		D Data transmission, telemetry, telecommand
C Vestigial sidebands		E Telephony
		F Television

Amplitude Modulated	Traditional Symbol	New Symbol
Unmodulated	AØ	NØN
Keyed on/off	A1	A1A
Tones keyed on/off	A2	A2A
AM data		A2D
Keyed tones w/SSB	A2J	J2A
SSB data		J2D
AM voice	A3	A3E
Voice w/SSB	A3J	J3E
AM facsimile	A4	A3C
SSB television	A5	C3F
AM television	A5	A3F

Frequency Modulated	Traditional Symbol	New Symbol
Unmodulated	FØ	NØN
Switched between two frequencies	F1	F1B
Switch tones	F2	F2A
FM data		F2D
FM voice	F3	F3E
FM facsimile	F4	F3C
FM television	F5	F3F
Pulse Modulated		
Phase	P	P1B

Source: FCC

New WARC Emission Symbols

3BA-10.2 On what frequencies within the 80-meter wavelength band may CW emissions be transmitted?

A. 3500-3750 kHz only
B. 3700-3750 kHz only
C. 3500-4000 kHz only
D. 3890-4000 kHz only

ANSWER C: Be sure to remember that CW, Morse code, may be transmitted on both CW sub-bands as well as on voice bands, too. This question is not asking where General Class CW privileges are, but rather where the emission CW may be broadcast.

3BA-10.3 On what frequencies within the 40-meter wavelength band may image emissions be transmitted?

A. 7225-7300 kHz only
B. 7000-7300 kHz only
C. 7100-7150 kHz only
D. 7150-7300 kHz only

ANSWER D: Image emissions include slow-scan television, and the new type of high resolution slow-scan television. Slow-scan television may be broadcast throughout the voice portion of the band, but only within the privileges of your license.

3BA-10.4 On what frequencies within the 30-meter wavelength band may RTTY emissions be transmitted?

A. 10.140-10.150 MHz only
B. 10.125-10.150 MHz only
C. 10.100-10.150 MHz only
D. 10.100-10.125 MHz only

ANSWER C: The 30-meter wavelength band is a popular one for radio teleprinter operation. RTTY may be broadcast throughout the entire 30-meter band.

3BA-10.5 On what frequencies within the 20-meter wavelength band may image emissions be transmitted?

A. 14,200-14,300 kHz only
B. 14,150-14,350 kHz only
C. 14,025-14,150 kHz only
D. 14,150-14,300 kHz only

ANSWER B: Another type of image transmission is radio facsimile. Facsimile may be used in the voice portion of the 20-meter band, but remember, use it only on those frequencies for which you are allocated voice privileges.

3BA-10.6 On what frequencies within the 15-meter wavelength band may image emission be transmitted?

A. 21,200-21,300 kHz only
B. 21,350-21,450 kHz only
C. 21,200-21,450 kHz only
D. 21,100-21,200 kHz only

ANSWER C: Here is another question on image emissions, and they may be broadcast on the voice portion of the 15-meter wavelength band.

3BA-10.7 On what frequencies within the 12-meter wavelength band may phone emissions be transmitted?

A. 24,890-24,990 kHz only
B. 24,890-24,930 kHz only
C. 24,930-24,990 kHz only
D. J3E is not permitted in this band

ANSWER C: The 12-meter wavelength band has plenty of excitement—and it's free from interference. Not many hams use it. You may operator single sideband from 24.930 MHz to 24.990 MHz.

3BA-10.8 On what frequencies within the 10-meter wavelength band may phone emissions be transmitted?

A. 28,000-28,300 kHz only
B. 29,000-29,700 kHz only
C. 28,300-29,700 kHz only
D. 28,000-29,000 kHz only

ANSWER C: Voice emissions on the 10-meter wavelength band span from 28,300 kHz to 29,700 kHz. When you were a Novice, you could only operate voice from 28.3 MHz to 28.5 MHz. Soon, as a General, your frequencies will expand dramatically!

3BA-13.1 What is the maximum sending speed permitted for data emissions below 28 MHz?

A. 56 kilobauds
B. 19.6 kilobauds
C. 300 bauds
D. 1200 bauds

ANSWER C: Below 28 MHz, data emissions like packet are restricted to a baud rate of 300 bauds. I know this sounds slow, but it is a lot faster than traditional RTTY or Morse code. We are limited to only 300 baud because the band width below 28 MHz is too narrow to legally allow wider bandwidth signals. The faster you send packet, the greater the bandwidth.

3BA-13.2 What is the maximum sending speed permitted for RTTY emissions below 28 MHz?

A. 56 kilobauds
B. 19.6 kilobauds
C. 1200 bauds
D. 300 bauds

ANSWER D: All terminal node controllers have provisions for accommodating different packet speeds. Below 28 MHz, 300 bauds is the maximum sending speed.

3BA-14.3 Under what circumstances, if any, may an amateur station engage in some form of broadcasting?

A. During severe storms, amateurs may broadcast weather information for people with scanners
B. Under no circumstances
C. If power levels under one watt are used, amateur stations may broadcast information bulletins, but not music
D. Amateur broadcasting is permissible above 10 GHz

ANSWER B: You may not play DJ on the air or pretend you are a news commentator. Only commercial broadcast stations can do that. However, if you really want to read the news, you are permitted to transmit ham radio news bulletins, code practice, group discussions, and handle news of amateur emergency communications or drills.

3BA-14.6 Which of the following is *not* a condition that allows an amateur station to engage in news gathering for broadcast purposes?

A. The information is more quickly transmitted by Amateur Radio
B. The information involves the immediate safety of life of individuals or the immediate protection of property
C. The information is directly related to the event
D. The information cannot be transmitted by other means

ANSWER A: Read this question carefully—they are asking what is NOT a condition that allows an amateur station to engage in news gathering. Just because ham radio may transmit information more quickly is not a legal condition that would allow us to use an amateur station for news gathering.

3BA-15.1 Under what circumstances, if any, may the playing of a violin be transmitted by an amateur station?

A. When the music played produces no dissonances or spurious emissions
B. When it is used to jam an illegal transmission
C. Only above 1215 MHz
D. Transmitting music is not permitted in the amateur service.

ANSWER D: If your author played the violin, it definitely would not sound like music—but nonetheless, violin playing and music are not allowed on the airwaves.

3BA-15.3 Under what circumstances, if any, may the playing of a piano be transmitted by an amateur station?

A. When it is used to jam an illegal transmission
B. Only above 1215 MHz
C. Transmitting music is not permitted in the amateur service.
D. When the music played produces no dissonances or spurious emissions

ANSWER C: Your author prides himself with being a great piano player, but unfortunately, he can't bore you with a sonata over the airwaves.

3BA-15.4 Under what circumstances, if any, may the playing of a harmonica be transmitted by an amateur station?

A. When the music played produces no dissonances or spurious emissions.
B. Transmitting music is not permitted in the amateur service.
C. When it is used to jam an illegal transmission
D. Only above 1215 MHz

ANSWER B: Your author can play "Home on the Range" on a harmonica, but not legally over the ham radio.

3BA-16.1 Under what circumstances, if any, may an amateur station in two-way communication transmit a message in a secret code in order to obscure the meaning of the communication?

A. Only above 450 MHz
B. Only on Field Day

C. Never
D. Only during a declared communications emergency

ANSWER C: Secret codes and scrambled transmissions are not allowed on the ham bands.

3BA-16.2 In an amateur communication, what types of abbreviations or procedural signals are not considered codes or ciphers?

A. Abbreviations and procedural signals certified by the ARRL
B. Abbreviations and procedural signals established by regulation or custom and usage and whose intent is to facilitate communication and not to obscure meaning
C. No abbreviations are permitted, as they tend to obscure the meaning of the message to FCC monitoring stations
D. Only "10-codes" are permitted

ANSWER B: Abbreviations are okay if everybody knows what they mean. An example would be the international Q signals where "QRT" means "I must stop sending." QSL my QSO? "Do you confirm my transmission?" Q signals are listed in the Appendix. The following chart list common radiotelephone words that are used by MARS and the US Army.

Proword	Meaning	Proword	Meaning
Affirmative	Yes	Negative	No, not received
All after	Say again all after _____	Number	Message number (in numerals) follows
All before	Say again all before _____	Out	End of transmission, no answer required or expected
Break	Used to separate message heading, text and ending	Over	End of transmission, answer is expected. Go ahead. Transmit.
Break	Stop transmitting	Roger	I have received your transmission satisfactorily
Correct	That is correct	Say again	Repeat
Figures	Numerals follow	Slant	Slant bar
From	Originator follows	This is	This transmission is from the station whose call follows
Groups	Numeral(s) indicating number of text words follows	Time	File time or date-time group of the message follows
Incorrect	That is incorrect	To	Addressee follows
Initial	Single letter follows	Wait	Short pause
I say again	I repeat	Wait out	Long pause
I spell	Phonetic spelling follows	Word after	Say again word after _____
Message follows	A message which requires recording follows	Word before	Say again word before _____
More to follow	I have more traffic for you		

MARS-Army Radiotelephone Prowords

3BA-16.3 When, if ever, are codes and ciphers permitted in two-way domestic Amateur Radio communications?

A. Codes or ciphers are prohibited under all circumstances.
B. Codes or ciphers are permitted during ARRL-sponsored contests.
C. Codes or ciphers are permitted during nationally declared emergencies.
D. Codes or ciphers are permitted above 2.3 GHz.

ANSWER A: You have been told once before, now again—codes and ciphers are not permitted!

3BA-16.4 When, if ever, are codes or ciphers permitted in two-way international Amateur Radio communications?

A. Codes or ciphers are prohibited under all circumstances.
B. Codes or ciphers are permitted during ITU-sponsored DX contests.
C. Codes or ciphers are permitted during internationally declared emergencies.
D. Codes or ciphers are permitted only on frequencies above 2.3 GHz.

ANSWER A: What, they ask this question again? No, codes and ciphers are not permitted!

Subelement 3BB – Operating Procedures (3 examination questions from 35 questions in 3BB)

3BB-1.4 What is meant by the term *flattopping* in a single-sideband phone transmission?

A. Signal distortion caused by insufficient collector current
B. The transmitter's automatic level control is properly adjusted.
C. Signal distortion caused by excessive drive
D. The transmitter's carrier is properly suppressed.

ANSWER C: If you drive your SSB transceiver with too much mike gain, it will go into distortion—causing the tips of your modulation envelope to flat top.

Oscilloscope Waveform Showing "Flattopping"

3BB-1.5 How should the microphone gain control be adjusted on a single-sideband phone transmitter?

A. For full deflection of the ALC meter on modulation peaks
B. For slight movement of the ALC meter on modulation peaks
C. For 100% frequency deviation on modulation peaks
D. For a dip in plate current

ANSWER B: Turn the mike gain down to about halfway for proper mike drive. Select "ALC" on your H.F. transceiver's output meter, and talk just close enough to the mike that the ALC meter ever so slightly deflects on voice peaks.

3BB-2.1 In what segment of the 20-meter wavelength band do most RTTY transmissions take place?

A. Between 14.000 and 14.050 MHz
B. Between 14.075 and 14.100 MHz
C. Between 14.150 and 14.225 MHz
D. Between 14.275 and 14.350 MHz

ANSWER B: RTTY is allowed on the CW portions of the 20-meter wavelength band. Most RTTY activity is centered between 14.075 MHz to 14.100 MHz.

3BB-2.2 In what segment of the 80-meter wavelength band do most RTTY emission transmissions take place?

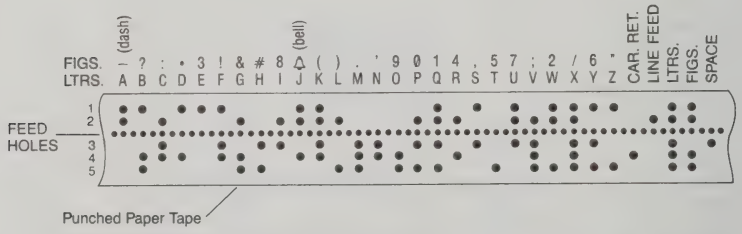
A. 3.610 to 3.630 MHz
B. 3500 to 3525 kHz
C. 3700 to 3750 kHz
D. 3.775 to 3.825 MHz

ANSWER A: On the 80-meter wavelength band, you'll find RTTY reception between 3610 kHz to 3630 kHz. Answer A is in MHz which moves the decimal point three places to the left.

3BB-2.3 What is meant by the term Baudot?

A. Baudot is a 7-bit code, with start, stop and parity bits.
B. Baudot is a 7-bit code in which each character has four mark and three space bits.
C. Baudot is a 5-bit code, with additional start and stop bits.
D. Baudot is a 6-bit code, with additional start, stop and parity bits.

ANSWER C: You pronounce it "baa doo". The "t" is silent; so if you take the "t" out of Baudot, it has just 5 letters in the word, and Baudot is a 5-bit code. RTTY radioteleprinter broadcasts use Baudot. Most worldwide ham radio stations operate at a speed of 45.5 baud (60 wpm). RTTY ham stations generally use a 170 Hz shift between the mark and space tones.



Baudot Code

3BB-2.4 What is meant by the term ASCII?

A. ASCII is a 7-bit code, with additional start, stop and parity bits.
B. ASCII is a 7-bit code in which each character has four mark and three space bits.
C. ASCII is a 5-bit code, with additional start and stop bits.
D. ASCII is a 5-bit code in which each character has three mark and two space bits.

ANSWER A: ASCII stands for American Standard Code for Information Interchange. This type of radioteleprinter communication runs faster and offers upper and lower case printing. Your answer has "parity bits" that makes it the correct answer—the parity bit allows the computer to detect received errors in the transmission.

Bit Position															
							0	1	0	1	1	0	0	1
							0	0	1	1	1	1	0	0
1	2	3	4	5	6	7	1	1	1	1	0	0	0	0
0	0	0	0				@	P	‘	p	0	sp	NUL	DLE
1	0	0	0				A	Q	a	q	1	!	SOH	DC1
0	1	0	0				B	R	b	r	2	”	STX	DC2
1	1	0	0				C	S	c	s	3	#	ETX	DC3
0	0	1	0				D	T	d	t	4	$	EOT	DC4
1	0	1	0				E	U	e	u	5	%	ENQ	NAK
0	1	1	0				F	V	f	v	6	&	ACK	SYN
1	1	1	0				G	W	g	w	7	’	BEL	ETB
0	0	0	1				H	X	h	x	8	(	BS	CAN
1	0	0	1				I	Y	i	y	9	)	HT	EM
0	1	0	1				J	Z	j	z	:	*	LF	SUB
1	1	0	1				K	[	k	{	;	+	VT	ESC
0	0	1	1				L	\	l	|	<	,	FF	FS
1	0	1	1				M	]	m	}	=	–	CR	GS
0	1	1	1				N	^	n	~	>	.	SO	RS
1	1	1	1				O	_	o	DEL	?	/	SI	US

American Standard Code for Information Interchange (ASCII)
Source: *Digital Communications with Packet Radio*, © 1988 Master Publishing, Inc., Richardson, Texas

3BB-2.6 What is the most common frequency shift for RTTY emissions in the amateur HF bands?

A. 85 Hz
B. 170 Hz
C. 425 Hz
D. 850 Hz

ANSWER B: Almost all ham radio transmissions use the 170 Hz shift. There are larger shift frequencies for commercial broadcast stations on shortwave.

3BB-2.10 What are the two subset modes of AMTOR?

A. A mark of 2125 Hz and a space of 2295 Hz
B. Baudot and ASCII
C. ARQ and FEC
D. USB and LSB

ANSWER C: When you listen to AMTOR, it sounds like two birds chirping. Actually you are hearing two computers communicating back and forth, checking for errors. ARQ stands for Automatic Repeat Request. FEC stands for Forward Error Correction.

3BB-2.11 What is the meaning of the term *ARQ*?

A. Automatic Repeater Queue
B. Automatic Receiver Quieting
C. Automatically Resend Quickly
D. Automatic Repeat Request

ANSWER D: Remember this is not an acronym; it is an abbreviation.

3BB-2.12 What is the meaning of the term *FEC*?

A. Frame Error Check
B. Forward Error Correction
C. Frequency Envelope Control
D. Frequency Encoded Connection

ANSWER B: In this case it could be an acronym, but it's still an abbreviation.

3BB-3.8 What is a band plan?

A. An outline adopted by Amateur Radio operators for operating within a specific portion of radio spectrum
B. An arrangement for deviating from FCC Rules and Regulations
C. A schedule for operating devised by the Federal Communications Commission
D. A plan devised for a club on how best to use a band during a contest

ANSWER A: It's important to know the band plan before transmitting on any Amateur Radio frequency. Just because you may have earned new privileges for a particular portion of the band does not necessarily mean you may operate any way you want on that band. Certain segments of the worldwide band may be reserved for working foreign stations. There are other segments on the worldwide band for slow scan television. There are also other segments for satellite reception. Remember, every band has a band plan and you must abide by the recommended band usage.

3BB-3.12 What is the usual input/output frequency separation for a 10-meter station in repeater operation?

A. 100 kHz
B. 600 kHz
C. 1.6 MHz
D. 170 Hz

ANSWER A: Believe it or not, there are repeaters on the 10-meter band from 29.5 to 29.7. Their input and output "split" is 100 kHz, transmitting low and coming out high.

3BB-4.1 What is meant by the term VOX transmitter control?

A. Circuitry that causes the transmitter to transmit automatically when the operator speaks into the microphone
B. Circuitry that shifts the frequency of the transmitter when the operator switches from radiotelegraphy to radiotelephony
C. Circuitry that activates the receiver incremental tuning in a transceiver
D. Circuitry that isolates the microphone from the ambient noise level

ANSWER A: Your worldwide set has a position for "VOX" operation. Make sure the switch is off or else any sound may trigger your set to transmit. If you touch the mike and the set goes silent and the transmitter light turns on, chances are you are accidentally in the VOX mode. Only operate VOX when there is no background noise.

3BB-4.2 What is the common name for the circuit that causes a transmitter to automatically transmit when a person speaks into the microphone?

A. VXO
B. VOX
C. VCO
D. VFO

ANSWER B: Set the microphone gain and the VOX sensitivity just to the point that your closely spoken words into the microphone trigger the VOX circuitry.

3BB-5.1 What is meant by the term full break-in telegraphy?

A. A system of radiotelegraph communication in which the breaking station sends the Morse Code symbols BK.
B. A system of radiotelegraph communication in which only automatic keyers can be used.
C. A system of radiotelegraph communication in which the operator must activate the send-receive switch after completing a transmission.
D. A system of radiotelegraph communication in which the receiver is sensitive to incoming signals between transmitted key pulses.

ANSWER D: Full break-in is abbreviated "QSK". It allows your transceiver to immediately pop back to receive in between all dots and dashes being sent. Only the more modern solid-state switching sets may accommodate QSK, and it's only useful to the CW operator that sends code quickly.

3BB-5.2 What Q signal is used to indicate full break-in telegraphy capability?

A. QSB
B. QSF
C. QSK
D. QSV

ANSWER C: Remember, it only becomes a question when followed by a question mark.

3BB-6.1 When selecting a CW transmitting frequency, what is the minimum frequency separation from a QSO in progress that should be allowed in order to minimize interference?

A. 5 to 50 Hz
B. 150 to 500 Hz
C. Approximately 3 kHz
D. Approximately 6 kHz

ANSWER B: It's a good idea to stay at least 1/2 kHz (500 hertz) away from a nearby CW transmission to avoid interference. Never transmit on a frequency when you can still hear portions of the other station's signal. If you begin transmitting, they too will hear portions of your signal. Although CW is a narrow mode of transmission, you still need some separation in order to prevent interference.

3BB-6.2 When selecting a single-sideband phone transmitting frequency, what is the minimum frequency separation from a QSO in progress that should be allowed in order to minimize interference?

A. 150 to 500 Hz between suppressed carriers
B. Approximately 3 kHz between suppressed carriers
C. Approximately 6 kHz between suppressed carriers
D. Approximately 10 kHz between suppressed carriers

ANSWER B: The Jiggly sound of single sideband requires a minimum of 3 kHz between signals. If you can hear someone clearly on SSB, tune a minimum of 3 kHz away until their signal completely disappears from your receiver before thinking you have an open frequency. Anything closer will cause splatter and a disgruntled ham.

3BB-6.3 When selecting a RTTY transmitting frequency, what is the minimum frequency separation from a QSO in progress that should be allowed in order to minimize interference?

A. Approximately 45 Hz center to center
B. Approximately 250 to 500 Hz center to center
C. Approximately 3 kHz center to center
D. Approximately 6 kHz center to center

ANSWER B: When selecting a clear RTTY frequency, adopt the same 1/2 kHz separation that you would for CW—staying at least 500 Hz away from a station already occupying a frequency.

3BB-7.1 What is an azimuthal map?

A. A map projection that is always centered on the North Pole.
B. A map projection, centered on a particular location, that determines the shortest path between two points on the surface of the earth.
C. A map that shows the angle at which an amateur satellite crosses the equator.
D. A map that shows the number of degrees longitude that an amateur satellite appears to move westward at the equator with each orbit.

ANSWER B: Long range communications do not necessarily go in straight lines! When we navigate our signals around the world, we need a map (actually, a chart) that takes into account the curvature of the earth. This azimuthal map will determine the shortest path between your station and that rare DX station.

3BB-7.2 How can an azimuthal map be helpful in conducting international HF radio communications?

A. It is used to determine the proper beam heading for the shortest path to a DX station.
B. It is used to determine the most efficient transmitting antenna height to conduct the desired communication.
C. It is used to determine the angle at which an amateur satellite crosses the equator.
D. It is used to determine the maximum usable frequency (MUF).

ANSWER A: Most of the time, aiming your directional beam antenna with azimuthal calculations will give you the best signal. This is called short-path transmission, and there are many charts published showing you beam headings to different parts of the world.

3BB-7.3 What is the most useful type of map when orienting a directional antenna toward a station 5,000 miles distant?

A. Azimuthal
B. Mercator
C. Polar projection
D. Topographical

ANSWER A: See 3BB-7.1 and 3BB-7.2

3BB-7.4 A directional antenna pointed in the long-path direction to another station is generally oriented how many degrees from the short-path heading?

A. 45 degrees
B. 90 degrees
C. 180 degrees
D. 270 degrees

ANSWER C: Some ionospheric conditions may allow you to establish communications with a distant station over a longer path around the world than the direct short path. If you hear the station with an echo, try your beam heading 180 degrees in the opposite direction to see whether or not they may be coming in better, but from a longer around-the-world distance!

3BB-7.5 What is the short-path heading to Antarctica?

A. Approximately 0 degrees
B. Approximately 90 degrees
C. Approximately 180 degrees
D. Approximately 270 degrees

ANSWER C: Modest antenna systems usually favor short-path transmission and reception. To talk to Antarctica, head your signal southbound to 180 degrees magnetic.

3BB-8.1 When permitted, transmissions to amateur stations in another country must be limited to only what type of messages?

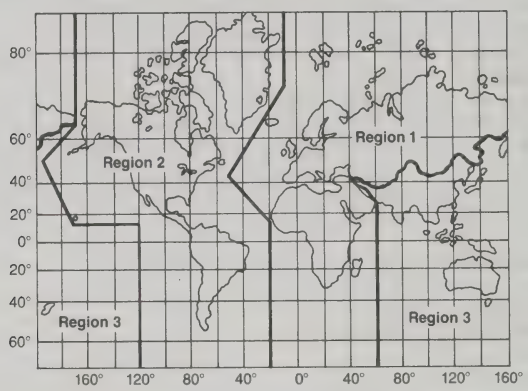
A. Messages of any type are permitted
B. Messages that compete with public telecommunications services
C. Messages of a technical nature or remarks of a personal character of relative unimportance
D. Such transmissions are never permitted

ANSWER C: It's fun to talk to hams in other countries. However, never talk politics or about controversial world affairs. Keep your communications to a technical nature or your remarks purely personal.

3BB-8.2 In which International Telecommunication Union Region is the continental United States?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER B: The world is divided up into three International Telecommunication Union Regions—here in the U.S., we are Region 2. After you go beyond Hawaii, the South Seas are Region 3. Europe is in Region 1.



ITC Regions

3BB-8.3 In which International Telecommunication Union Region is Alaska?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER B.

3BB-8.4 In which International Telecommunication Union Region is American Samoa?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER C: There you are sunning yourself on this island in the South Seas. Samoa is in Region 3.

3BB-8.5 For uniformity in international radio communication, what time measurement standard should amateur operators worldwide use?

A. Eastern Standard Time
B. Uniform Calibrated Time
C. Coordinated Universal Time
D. Universal Time Control

ANSWER C: Our local times throughout the world will vary. Hams use Coordinated Universal Time as the standard "Zulu" time for worldwide communications. This is sometimes known as Greenwich Mean Time (GMT). It may also be referred to as "U.T.C.", literally describing Universal Time Coordinated. Watch out for incorrect answer D!

3BB-8.6 In which International Telecommunication Union Region is Hawaii?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER B: Hawaii is still within the same region as the United States, Region 2.

3BB-8.7 In which International Telecommunication Union Region are the Northern Mariana Islands?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER C: These islands are well beyond Hawaii, so they fall into Region 3.

3BB-8.8 In which International Telecommunication Union Region is Guam?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER C: Same thing here—beyond Hawaii, it's Region 3.

3BB-8.9 In which International Telecommunication Union Region is Wake Island?

A. Region 1
B. Region 2
C. Region 3
D. Region 4

ANSWER C: Once again, beyond Hawaii, Region 3.

3BB-10.1 What is the Amateur Auxiliary to the FCC's Field Operations Bureau?

A. Amateur Volunteers formally enlisted to monitor the airwaves for rules violations
B. Amateur Volunteers who conduct Amateur Radio licensing examinations
C. Amateur Volunteers who conduct frequency coordination for amateur VHF repeaters
D. Amateur Volunteers who determine height above average terrain measurements for repeater installations

ANSWER A: Ham radio operators assist in policing their own airwaves. The amateur Auxiliary, working with the FCC, may help straighten out some problem cases where on the air hams may not be operating correctly. It's important to always take the well-meaning suggestions of an amateur auxiliary member, especially if they indicate you may be accidentally violating one of the FCC rules.

3BB-10.2 What are the objectives of the Amateur Auxiliary to the FCC's Field Operations Bureau?

A. To enforce amateur self-regulation and compliance with the rules
B. To foster amateur self-regulation and compliance with the rules

C. To promote efficient and orderly spectrum usage in the repeater sub-bands
D. To provide emergency and public safety communications

ANSWER B: Amateur operators pride themselves on self-regulation.

Subelement 3BC – Radio-Wave Propagation (3 examination questions from 30 questions in 3BC

3BC-1.6 What is the maximum distance along the earth's surface that can normally be covered in one hop using the F2 layer?

A. Approximately 180 miles
B. Approximately 1200 miles
C. Approximately 2500 miles
D. No distance. This layer does not support radio communication.

ANSWER C: Since the F2 layer is the highest layer in the ionosphere, we get the greatest range. 2500 miles is best remembered as being coast-to-coast communications.

Layers	Day		Night
	Summer	Winter	
F2	>250		
F1	90-150		
F		90-150	90-250
E	55-90	55-90	
D	40	40	

Ionesphere Altitudes in Miles

3BC-1.7 What is the maximum distance along the earth's surface that can be covered in one hop using the E layer?

A. Approximately 180 miles
B. Approximately 1200 miles
C. Approximately 2500 miles
D. No distance. This layer does not support radio communication.

ANSWER B: The E layer is not as high as the F layer. You will only get about halfway across the United States with E-layer skip (1,200 miles).

3BC-1.9 What is the average height of maximum ionization of the E layer?

A. 45 miles
B. 70 miles
C. 200 miles
D. 1200 miles

ANSWER B: The chart of the ionospheric layers shows periods of the day when each layer is present and the layers' altitude. (See chart at question 3BC-1.6)

3BC-1.10 During what part of the day, and in what season of the year can the F2 layer be expected to reach its maximum height?

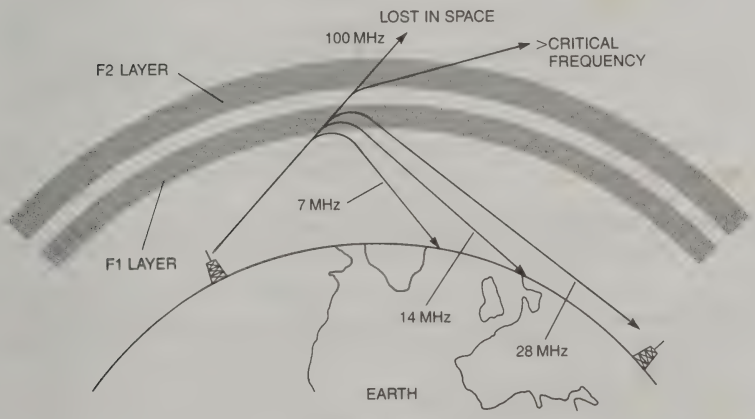
A. At noon during the summer
B. At midnight during the summer
C. At dusk in the spring and fall
D. At noon during the winter

ANSWER A: The ionospheric layers get their greatest charge and reach their furthest height when the sun is at maximum intensity. You always get your worst sunburn at noon during the summer on the beach.

3BC-1.13 What is the critical angle, as used in radio wave propagation?

A. The lowest take off angle that will return a radio wave to earth under specific ionospheric conditions
B. The compass direction of the desired DX station from your location
C. The 180-degree-inverted compass direction of the desired DX station from your location
D. The highest take off angle that will return a radio wave to earth during specific ionospheric conditions

ANSWER D: Have you ever skipped stones on a lake. There is an angle that you cannot exceed where the stone doesn't skip, but rather dives right into the water. Similar to radio waves and the ionosphere, there is a point at the highest take-off angle that may or may not return a radio wave back to earth. Just remember it's the "highest take-off angle". In addition, keep in mind that the ionosphere is up high.



Critical Frequency

Source: *Antennas — Selection and Installation*, © 1986 Master Publishing, Inc., Richardson, Texas

3BC-2.3 What is the main reason that the 160-, 80-, and 40-meter wavelength amateur bands tend to be useful for only short-distance communications during daylight hours?

A. Because of a lack of activity
B. Because of auroral propagation
C. Because of D-layer absorption
D. Because of magnetic flux

ANSWER C: Many hams, during daylight hours, use 160 meters, 80 meters, and 40 meters only for very short-range communications. The long-range skywaves are absorbed by the D layer, so short-range communications are virtually interference free.

3BC-2.4 What is the principal reason the 160-meter through 40-meter wavelength bands are useful for only short-distance radio communications during daylight hours?

A. F-layer bending
B. Gamma radiation
C. D-layer absorption
D. Tropospheric ducting

ANSWER C: D for daylight. During daylight hours, the darn D layer acts as a low and medium frequency radio wave sponge.

3BC-3.3 If the maximum usable frequency on the path from Minnesota to Africa is 22 MHz, which band should offer the best chance for a successful QSO?

A. 10 meters
B. 15 meters
C. 20 meters
D. 40 meters

ANSWER B: If you can hear Africa on 22 MHz on commercial shortwave frequencies, your best band to work African amateurs would be on the closest ham band down—the 21 MHz or 15-meter band.

3BC-3.4 If the maximum usable frequency on the path from Ohio to West Germany is 17 MHz, which band should offer the best chance for a successful QSO?

A. 80 meters
B. 40 meters
C. 20 meters
D. 2 meters

ANSWER C: If Germany is coming in well on 17 MHz commercial frequencies, chances are the best band for ham communications will be the 14-MHz band (20 meters).

3BC-5.1 Over what periods of time do sudden ionospheric disturbances normally last?

A. The entire day
B. A few minutes to a few hours
C. A few hours to a few days
D. Approximately one week

ANSWER B: The sun predictably gives off sudden bursts of solar energy. These gigantic eruptions on the face of the sun may last a few minutes to a few hours, and are called "SIDs." This solar energy has greatest influence on the lowest ionospheric layer, the D layer. Since the D layer absorbs radio signals, the lower frequency ham bands are most effected. In the northern latitudes, you can even see the extra charged D layer glow right after sunset.

3BC-5.2 What can be done at an amateur station to continue radio communications during a sudden ionospheric disturbance?

A. Try a higher frequency
B. Try the other sideband
C. Try a different antenna polarization
D. Try a different frequency shift

ANSWER A: During a SID where lower frequencies are absorbed by the D layer, try some higher frequency bands and see if a higher frequency will get through. One generally will.

3BC-5.3 What effect does a sudden ionospheric disturbance have on the daylight ionospheric propagation of HF radio waves?

A. Disrupts higher-latitude paths more than lower-latitude paths
B. Disrupts transmissions on lower frequencies more than those on higher frequencies
C. Disrupts communications via satellite more than direct communications
D. None. Only dark (as in nighttime) areas of the globe are affected.

ANSWER B: The lower frequencies, such as 160, 80, 40, and even 20 meters, sometimes go out first during a SID.

3BC-5.4 How long does it take a solar disturbance that increases the sun's ultraviolet radiation to cause ionospheric disturbances on earth?

A. Instantaneously
B. 1.5 seconds
C. 8 minutes
D. 20 to 40 hours

ANSWER C: Ultraviolet radiation travels at the speed of light. It takes exactly 8 minutes for sunlight and ultraviolet rays to reach the Earth's ionosphere. However, charged particles from a SID move a lot slower than light, and they may take up to 2 days to finally reach our ionospheric layers.

3BC-5.5 Sudden ionospheric disturbances cause increased radio wave absorption in which layer of the ionosphere?

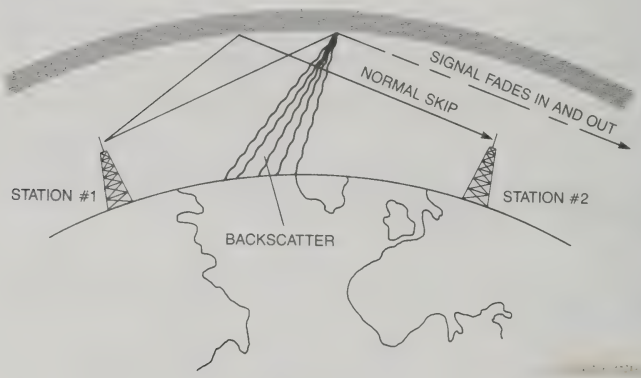
A. D layer
B. E layer
C. F1 layer
D. F2 layer

ANSWER A: Always remember that the darn D layer absorbs.

3BC-6.2 What is a characteristic of backscatter signals?

A. High intelligibility
B. A wavering sound
C. Reversed modulation
D. Reversed sidebands

ANSWER B: Sometimes radio waves will reflect back from densely ionized sections of the ionosphere. This random scattering of signal may momentarily cancel or enhance regular skywave propagation to a distant station. This makes the signal you are receiving fade in and out, and sometimes sound distorted with a wavering sound. Many hams use backscatter to fill in a skip zone that normally they would not receive at all.



Backscatter

3BC-6.4 What makes backscatter signals often sound distorted?

A. Auroral activity and changes in the earth's magnetic field
B. The propagation through ground waves that absorb much of the signal's clarity
C. The earth's E-layer at the point of radio wave refraction
D. The small part of the signal's energy scattered back to the transmitter skip zone through several radio-wave paths

ANSWER D: It takes a lot of power to take advantage of back scatter, but it's a fun way to stay in touch with hams over distances that are normally too close for skywaves, but too far away for groundwaves.

3BC-6.5 What is the radio wave propagation phenomenon that allows a signal to be detected at a distance too far for ground wave propagation but too near for normal sky wave propagation?

A. Ground wave
B. Scatter
C. Sporadic-E skip
D. Short path skip

ANSWER B: You will need a directional antenna to take advantage of backscatter for best results.

3BC-6.6 When does ionospheric scatter propagation on the HF bands most often occur?

A. When the sunspot cycle is at a minimum
B. At night
C. When the F1 and F2 layers are combined
D. At frequencies above the maximum usable frequency

ANSWER A: Scatter intensifies during periods of low sunspot activity. Try your backscatter techniques on the 10-and 15-meter bands after sunset.

3BC-7.1 What is solar flux?

A. The density of the sun's magnetic field
B. The radio energy emitted by the sun
C. The number of sunspots on the side of the sun facing the earth
D. A measure of the tilt of the earth's ionosphere on the side toward the sun

ANSWER B: We can actually measure the radio energy emitted by the sun with special receiving equipment. You can also test your antenna systems by aiming them at the sun and listening for the receiver noise to increase.

3BC-7.2 What is the solar-flux index?

A. A measure of past measurements of solar activity
B. A measurement of solar activity that compares daily readings with results from the last six months
C. Another name for the American sunspot number
D. A measure of solar activity that is taken daily

ANSWER D: The solar-flux index is measured daily in Ottawa, Canada on a frequency of 2800 MHz, late every afternoon. You may tune into the radio wave propagational forecast transmitted by WWV and WWVH at 18 minutes pass the hour on 5 MHz, 10 MHz, 15 MHz, and 20 MHz, AM or USB. These 45-second reports, every hour, give you the latest ionospheric conditions. Try tuning them in right now!

3BC-7.3 What is a timely indicator of solar activity?

A. The 2800 MHz solar flux index
B. The mean Canadian sunspot number
C. A clock set to Coordinated Universal Time
D. Van Allen radiation measurements taken at Boulder, Colorado

ANSWER A: See question 3BC-7.2.

3BC-7.4 What type of propagation conditions on the 15-meter wavelength band are indicated by a solar-flux index value of 60 to 70?

A. Unpredictable ionospheric propagation
B. No ionospheric propagation is possible
C. Excellent ionospheric propagation
D. Poor ionospheric propagation

ANSWER D: Remember the solar-flux values as being similar to the grades you got in school. A 60 to 70 percent grade is poor.

3BC-7.5 A solar-flux index in the range of 90 to 110 indicates what type of propagation conditions on the 15-meter band?

A. Poor ionospheric propagation
B. No ionospheric propagation is possible
C. Unpredictable ionospheric propagation
D. Good ionospheric propagation

ANSWER D: Get 90 to 110 percent on an exam, and that's "good."

3BC-7.6 A solar-flux index of greater than 120 would indicate what type of propagation conditions on the 10-meter band?

A. Good ionospheric propagation
B. Poor ionospheric propagation
C. No ionospheric propagation is possible
D. Unpredictable ionospheric propagation

ANSWER A: 120 percent on an exam is great.

3BC-7.7 For widespread long distance openings on the 6-meter band, what solar-flux index values would be required?

A. Less than 50
B. Approximately 75
C. Greater than 100
D. Greater than 250

ANSWER D: If WWV calls for a solar-flux index greater than 250, radio communications via skywave are possible on frequencies dramatically higher than the usual high frequency band limits. During summer months, and during a short period in December, it's possible for radio signals on 6 meters, 2 meters, and even 220 MHz to briefly reflect off of super-reflective ionospheric patches and come back down several thousand miles away. Look for these extra- ordinary VHF conditions when the solar flux is near 200 or higher.

3BC-7.8 If the MUF is high and HF radio communications are generally good for several days, a similar condition can usually be expected how many days later?

A. 7 days
B. 14 days
C. 28 days
D. 90 days

ANSWER C: Did you ever wonder why there are around 29 days in a month? This is the sun's rotational cycle, and you can always expect that sunspots on the face of the sun will reoccur every 28 to 29 days giving hams a clue what band conditions may be one month from today. In fact, there are publishers of radio forecasts that are very accurate in predicting what the conditions will be like over the next 2 or 3 months, and what days will be "hotter" than other days on the airwaves.

3BC-10.1 What is a geomagnetic disturbance?

A. A sudden drop in the solar-flux index
B. A shifting of the earth's magnetic pole
C. Ripples in the ionosphere
D. A dramatic change in the earth's magnetic field over a short period of time

ANSWER D: During periods of intense solar activity, the sun's effect on our magnetic field may dramatically change radio wave propagation. These magnetic disturbances affect the earth's magnetic field.

3BC-10.2 Which latitude paths are more susceptible to geomagnetic disturbances?

A. Those greater than 45 degrees latitude
B. Those less than 45 degrees latitude

C. Equatorial paths
D. All paths are affected equally

ANSWER A: The greatest effect of magnetic disturbances are seen north of latitude 45. This is also where you will see the aurora borealis, or the northern lights. The northern lights are usually associated with a geomagnetic disturbance.

3BC-10.3 What can be the effect of a major geomagnetic storm on radio communications?

A. Improved high-latitude HF communications
B. Degraded high-latitude HF communications
C. Improved ground-wave propagation
D. Improved chances of ducting at UHF

ANSWER B: During "radio storms", the D layer becomes highly ionized, and this degrades worldwide H.F. communications in high latitudes greater than 45 degrees.

3BC-10.4 How long does it take a solar disturbance that increases the sun's radiation of charged particles to affect radio wave propagation on earth?

A. The effect is instantaneous
B. 1.5 seconds
C. 8 minutes
D. 20 to 40 hours

ANSWER D: Charged particles are those slower-moving elements from the sun that may take up to 2 days to arrive. Since the effects of sunspots can be seen within 8 minutes after they occur, this gives hams a good 1-1/2 days to reliably predict an impending radio storm. Listen to WWV at 18 minutes past the hour for the radiation predictions. Any shortwave receiver that can tune into the 10-or 15-MHz band can easily hear the WWV signals from Denver, or WWVH signals from Hawaii.

Subelement 3BD – Amateur Radio Practice (5 examination questions from 50 questions in 3BD)

3BD-1.5 Which wires in a four conductor line cord should be attached to fuses in a 234 VAC primary (single-phase) power supply?

A. Only the "hot" (black and red) wires
B. Only the "neutral" (white) wire
C. Only the ground (bare) wire
D. All wires

ANSWER A: When you talk about house wiring, you must forget about the red and black wires that indicate positive and negative voltage found in your automobile. On 220 volt house power, the two hot wires are always fused. They are the red and black wires. The white neutral wire is never fused and the green or bare ground wire is never, never, never fused!

3BD-1.6 What size wire is normally used on a 15-ampere, 117-VAC household lighting circuit?

A. AWG number 14
B. AWG number 16
C. AWG number 18
D. AWG number 22

ANSWER A: Number 14 wire can easily handle 15 amperes (amps) of current. This is fine to run an electric can opener.

3BD-1.7 What size wire is normally used on a 20-ampere, 117-VAC household appliance circuit?

A. AWG number 20
B. AWG number 16
C. AWG number 14
D. AWG number 12

ANSWER D: To run your microwave oven, you need larger wire, such as 12 gauge. The smaller the wire number, the bigger the wire. Large wire provides greater current capacity.

Wire Size A.W.G. (BFS)	Current-Amps (Continuous Duty)	
	Single Wire	Bundled Wire
8	73	46
10	55	33
12	41	23
14	32	17
16	22	13
18	16	10

Wire Size vs. Current Capability

3BD-1.8 What could be a cause of the room lights dimming when the transmitter is keyed?

A. RF in the ac pole transformer
B. High resistance in the key contacts
C. A drop in ac line voltage
D. The line cord is wired incorrectly

ANSWER C: It's quite common that your room lights will dim when transmitting on a wolrdwide ham transceiver. Most worldwide ham sets draw from 10 to 15 amps of 117 VAC on voice peaks. This causes a small drop in supply voltage, which you will see as a slight dimming of the lights.

3BD-1.9 What size fuse should be used on a #12-wire household appliance circuit?

A. Maximum of 100 amperes
B. Maximum of 60 amperes
C. Maximum of 30 amperes
D. Maximum of 20 amperes

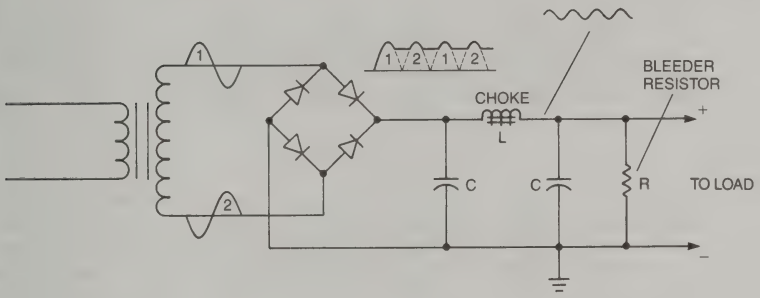
ANSWER D: Since a bundled number 12 wire may safely handle up to 23 amps of current, you would use a 20 ampere fuse in series with this wire.

3BD-2.4 What safety feature is provided by a bleeder resistor in a power supply?

A. It improves voltage regulation.
B. It discharges the filter capacitors.
C. It removes shock hazards from the induction coils.
D. It eliminates ground-loop current.

ANSWER B: High voltage may remain on an electrolytic capacitor for several days unless it is safely discharged to ground. Bleeder resistors normally take the "head"

off of any high voltage in a big capacitor after you turn off your power supply. The bleeder resistor also improves voltage regulation, but that's of secondary importance and not the correct answer choice in this case.



Full-Wave Power Supply with Bleeder Resistor

3BD-3.1 What kind of input signal is used to test the amplitude linearity of a single-sideband phone transmitter while viewing the output on an oscilloscope?

A. Normal speech
B. An audio-frequency sine wave
C. Two audio-frequency sine waves
D. An audio-frequency square wave

ANSWER C: We use two audio tones to test for proper linearity while viewing the tones on an oscilloscope. These pure tones, not harmonically related, will give you a nice stable picture on the scope if your transmitter amplifier has proper linearity. Simply whistling won't make it!

3BD-3.2 To test the amplitude linearity of a single-sideband phone transmitter with an oscilloscope, what should the audio input to the transmitter be?

A. Normal speech
B. An audio-frequency sine wave
C. Two audio-frequency sine waves
D. An audio-frequency square wave

ANSWER C: Each of the two tones must be a perfectly generated pure sine wave. Two-tone test generators are available for this purpose.

3BD-3.3 How are two tones used to test the amplitude linearity of a single-sideband phone transmitter?

A. Two harmonically related audio tones are fed into the microphone input of the transmitter, and the output is observed on an oscilloscope.
B. Two harmonically related audio tones are fed into the microphone input of the transmitter, and the output is observed on a distortion analyzer.
C. Two non-harmonically related audio tones are fed into the microphone input of the transmitter, and the output is observed on an oscilloscope.
D. Two non-harmonically related audio tones are fed into the microphone input of the transmitter, and the output is observed on a wattmeter.

ANSWER C: Many hams sets may have an accessory station monitor oscilloscope as an added feature. Use this monitor scope to double check that you have proper modulation by looking at the wave form of the two tones fed into the mike circuit.

a. Properly Adjusted

b. Distortion

Two-Tone Test

3BD-3.4 What audio frequencies are used in a *two-tone test* of the linearity of a single-sideband phone transmitter?

A. 20 Hz and 20,000 Hz tones must be used.
B. 1200 Hz and 2400 Hz tones must be used.
C. Any two audio tones may be used, but they must be within the transmitter audio passband, and must be harmonically related.
D. Any two audio tones may be used, but they must be within the transmitter audio passband, and should not be harmonically related.

ANSWER D: Adjust your two-tone generator so that the two audio tones are not harmonically related, and are low enough in frequency to be passed through the transmitter audio circuitry.

3BD-3.5 What can be determined by making a *two-tone test* using an oscilloscope?

A. The percent of frequency modulation
B. The percent of carrier phase shift
C. The frequency deviation
D. The amplifier linearity

ANSWER D: Remember, the input tones must be pure sine waves and the oscilloscope output will be stable if the amplifier linearity is proper.

3BD-4.1 How can the grid-current meter in a power amplifier be used as a neutralizing indicator?

A. Tune for minimum change in grid current as the output circuit is changed
B. Tune for maximum change in grid current as the output circuit is changed
C. Tune for minimum grid current
D. Tune for maximum grid current

ANSWER A: If you change power output tubes in your linear power amplifier, you may need to "neutralize" the amplifier to insure your signal is absolutely clean with no parasitic oscillations. When the neutralizing capacitor is properly adjusted, there will be minimum change on your grid-current meter when making small adjustments to the plate tank capacitor. Carefully read the neutralization instructions in your owner's manual before attempting to replace tubes and re-neutralize your power amplifier circuits.

3BD-4.2 Why is neutralization in some vacuum tube amplifiers necessary?

A. To reduce the limits of loaded Q in practical tuned circuits
B. To reduce grid to cathode leakage
C. To cancel acid build-up caused by thorium oxide gas
D. To cancel oscillation caused by the effects of interelectrode capacitance

ANSWER D: Even similar numbered tubes for power amplifiers may exhibit a slight change in the interelectrode capacitance in the rf stage of your power amplifier. An amplifier that "hangs up" on modulation peaks after new tubes are inserted is probably going into feedback, and if this condition persists for more than a few seconds, you could very easily damage those brand new tubes you just put in. Follow your amplifier neutralization instructions carefully.

3BD-4.3 How is neutralization of an rf amplifier accomplished?

A. By supplying energy from the amplifier output to the input on alternate half cycles
B. By supplying energy from the amplifier output to the input shifted 360 degrees out of phase
C. By supplying energy from the amplifier output to the input shifted 180 degrees out of phase
D. By supplying energy from the amplifier output to the input with a proper dc bias

ANSWER C: The key to neutralizing the amplifier is to take a small amount of output, shift it 180 degrees, and feed it to the input. This phase difference will cancel feedback caused by interelectrode capacity. Again, follow the instructions to the letter in your power amplifier instruction manual.

3BD-4.4 What purpose does a neutralizing circuit serve in an rf amplifier?

A. It controls differential gain.
B. It cancels the effects of positive feedback.
C. It eliminates circulating currents.
D. It reduces incidental grid modulation.

ANSWER B: You know exactly what a P.A. system sounds like when it has feedback—a deafening howl. You can imagine what's occurring inside your amplifier when it goes into feedback. It could be an expensive "howl" that ruins those two new tubes unless you have properly neutralized your equipment.

3BD-4.5 What is the reason for neutralizing the final amplifier stage of a transmitter?

A. To limit the modulation index
B. To eliminate parasitic oscillations
C. To cut off the final amplifier during standby periods
D. To keep the carrier on frequency

ANSWER B: An amplifier allowed to go into oscillation may self-destruct in just a few seconds.

3BD-5.1 How can the output PEP of a transmitter be determined with an oscilloscope?

A. Measure peak load voltage across a resistive load with an oscilloscope, and calculate, using PEP = [(Vp)(Vp)]/(RL)
B. Measure peak load voltage across a resistive load with an oscilloscope, and calculate, using PEP = [(0.707 PEV)(0.707 PEV)]/RL
C. Measure peak load voltage across a resistive load with an oscilloscope, and calculate, using PEP = (Vp)(Vp)(RL)
D. Measure peak load voltage across a resistive load with an oscilloscope, and calculate, using PEP = [(1.414 PEV)(1.414 PEV)]/RL

ANSWER B: PEP is peak envelope power. It is the maximum power that the transmitter will generate. Simply memorize the equation and be able to look it up if ever you need to calculate the peak envelope power of your transmitter using an oscilloscope. Most hams would use a peak reading meter for an easier way to determine this problem. Many students remember the correct answer by spotting those two "0.707s" which give the effective value of the rf voltage used to calculate the power. Remember PEV is peak envelope voltage so it is one-half the peak-to-peak value.

3BD-5.5 What is the output PEP from a transmitter when an oscilloscope shows 200 volts peak-to-peak across a 50-ohm resistor connected to the transmitter output terminals?

A. 100 watts
B. 200 watts
C. 400 watts
D. 1000 watts

ANSWER A: Let's try the equation given in the correct Answer B of question 3BD-5.1 for this problem.

$$\text{Peak envelope power output} = \frac{(\text{Peak voltage} \times 0.707)^2}{\text{resistance of the load}}$$

Remember, peak voltage is one half of the peak-to-peak value. Multiply 100 × 0.707 (clear, 100 × 0.707 = 70.7), square the result (clear, 70.7 × 70.7 = 4998.49), and divide by 50 (4998.49 ÷ 50 = 99.97). The answer is 100 watts. Calculator keystrokes are shown within parentheses. 99.97 watts is rounded off to 100 to give Answer A.

3BD-5.6 What is the output PEP from a transmitter when an oscilloscope shows 500 volts peak-to-peak across a 50-ohm resistor connected to the transmitter output terminals?

A. 500 watts
B. 625 watts
C. 1250 watts
D. 2500 watts

ANSWER B: Same approach using the equation of 3BD-5.1B—multiply 250 × .707 (clear, 250 × 0.707 = 176.75), and square the result, (176.75 × 176.75 = 31240.56). Now divide 50 into the result, (31240.56 ÷ 50 = 624.81), and you should end up with 625 watts (rounded off).

3BD-5.7 What is the output PEP of an unmodulated carrier transmitter when an average-reading wattmeter connected to the transmitter output terminals indicates 1060 watts?

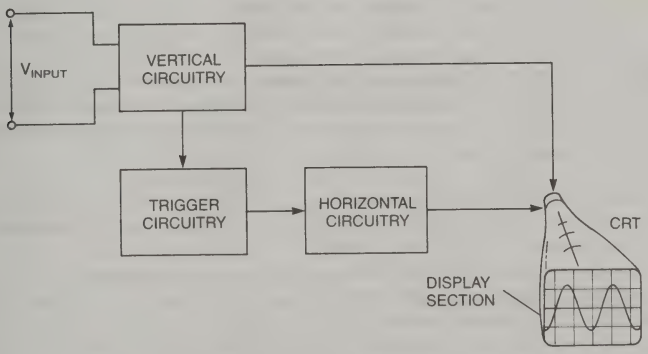
A. 530 watts
B. 1060 watts
C. 1500 watts
D. 2120 watts

ANSWER B: A transmitter with no modulation is putting out 1060 watts average, as well as 1060 watts peak, because a steady unmodulated carrier has the same average and peak power levels.

3BD-6.1 What item of test equipment contains horizontal and vertical channel amplifiers?

A. The ohmmeter
B. The signal generator
C. The ammeter
D. The oscilloscope

ANSWER D: An oscilloscope is always your best piece of test equipment in Amateur Radio technical work. Your examinations will always ask what's the very best piece of gear to have around, and you should always answer "an oscilloscope."



Simplified Diagram of an Oscilloscope

3BD-6.2 What types of signals can an oscilloscope measure?

A. Any time-dependent signal within the bandwidth capability of the instrument
B. Blinker-light signals from ocean-going vessels
C. International nautical flag signals
D. Signals created by aeronautical flares

ANSWER A: Look at the wrong answers and you can easily figure out the right answer! The beauty of an oscilloscope is it will show you an instantaneous radio wave within the bandwidth capability of the oscillosocpe.

3BD-6.3 What is an oscilloscope?

A. An instrument that displays the radiation resistance of an antenna.
B. An instrument that displays the SWR on a feed line.
C. An instrument that displays the resistance in a circuit.
D. An instrument that displays signal waveforms.

ANSWER D: You can carefully analyze your transmitted signal waveform by watching the oscillosocpe during a two-tone test or during normal modulation. See patterns in question 3BD-3.3.

3BD-6.4 What can cause phosphor damage to an oscilloscope cathode ray tube?

A. Directly connecting deflection electrodes to the cathode ray tube
B. Too high an intensity setting
C. Overdriving the vertical amplifier
D. Improperly adjusted focus

ANSWER B: Always turn the scope (common term for oscilloscope) off when not in use, or at least turn down the intensity so the trace or dot disappears. If you don't, that little tiny bright dot at the center of the screen when you don't have a wave form defection could permanently blacken the phosphor coating on the front of the tube.

3BD-9.1 What is a signal tracer?

A. A direction-finding antenna
B. An aid for following schematic diagrams
C. A device for detecting signals in a circuit
D. A device for drawing signal waveforms

ANSWER C: Signal tracers are a handy item to locate the defective stages in a radio receiver. It allows you to methodically eliminate, one by one, possible receiver stages that may be working properly in order to find that one stage that may have a blown transistor.

3BD-9.2 How is a signal tracer used?

A. To detect the presence of a signal in the various stages of a receiver
B. To locate a source of interference
C. To trace the path of a radio signal through the ionosphere
D. To draw a waveform on paper

ANSWER A: A signal tracer provides a source signal to the point in the circuit chosen by you. With normal receiver volume, you can usually hear the tone of the signal tracer coming through to the speaker. Most hams start at the speaker circuit and work backwards stage by stage until the tone abruptly disappears. A thorough check of the suspected stage usually reveals the problem.

3BD-9.3 What is a signal tracer normally used for?

A. To identify the source of radio transmissions
B. To make exact replicas of signals
C. To give a visual indication of standing waves on open-wire feed lines
D. To identify an inoperative stage in a radio receiver

ANSWER D: When a receiver stage doesn't allow the signal from the signal tracer to pass through, you usually have located the inoperative stage.

3BD-10.1 What is the most effective way to reduce or eliminate audio frequency interference to home entertainment systems?

A. Install bypass inductors
B. Install bypass capacitors
C. Install metal oxide varistors
D. Install bypass resistors

ANSWER B: Your worldwide General Class amateur station may cause interference to your home electronics or electronic systems of your neighbors on each side of your house. The signal might come through on an intercom, or it also could come through on the telephone. Bypass capacitors, usually 0.001 microfarad disk capacitors, may eliminate or reduce audio interference to a home electronic set. The leads must be kept as short as possible, and they must be bypassed to a good rf ground. You may need to experiment to find just the right combination that will eliminate the interference from coming into the system.

Unfortunately, most home electronic equipment does not contain circuitry to minimize the effects of strong rf fields. This makes many pieces of home entertainment electronic equipment very susceptible to your high frequency Amateur Radio signals. It's unlikely that you will go on the air with a worldwide system and not have some sort of electronic interference to you, or your neighbor. It takes collective work to resolve the problem.

3BD-10.2 What should be done when a properly-operating amateur station is the source of interference to a nearby telephone?

A. Make internal adjustments to the telephone equipment
B. Contact a phone service representative about installing RFI filters
C. Nothing can be done to cure the interference
D. Ground and shield the local telephone distribution amplifier

ANSWER B: The new breed of inexpensive electronic telephones are ripe for collecting radio interference. Since these sets have been purchased privately, not many phone companies will come out and troubleshoot. However, you may pay your telephone company to install filters on your equipment, so give it a try—but don't expect the service to be free.

3BD-10.3 What sound is heard from a public address system when audio rectification occurs in response to a nearby single-sideband phone transmission?

A. A steady hum that persists while the transmitter's carrier is on the air
B. On-and-off humming or clicking
C. Distorted speech from the transmitter's signals
D. Clearly audible speech from the transmitter's signals

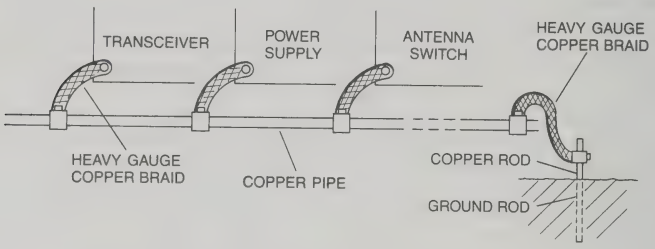
ANSWER C: Single sideband worldwide transmissions will not sound clear when it comes over your neighbor's P.A. intercom. It will sound distorted. However, if you were running Morse code, your neighbor will hear an on-and-off humming. If you are running double-sideband AM, such as that from a CB radio, your neighbor will hear clear audio speech.

3BD-10.4 How can the possibility of audio rectification occurring be minimized?

A. By using a solid state transmitter
B. By using CW emission only

C. By ensuring all station equipment is properly grounded
D. By using AM emission only

ANSWER C: Grounding will assist in reducing interference to your neighbor's equipment. Many times grounding the chassis of their equipment may help, too. Ground with something flat and large for maximum grounding effect. Grounding braid or grounding foil will minimize the effects of "reactance" caused by using only a small ground wire. A tiny little wire from your station to the cold water pipe is not a good ground.



Grounding Equipment

3BD-10.5 What sound is heard from a public address system when audio rectification occurs in response to a nearby double-sideband phone transmission?

A. Audible, possibly distorted speech from the transmitter signals
B. On-and-off humming or clicking
C. Muffled, distorted speech from the transmitter's signals
D. Extremely loud, severely distorted speech from the transmitter's signals

ANSWER A: A double-sideband phone transmission is what comes out of a CB radio, so the signal will be audible with little distortion.

3BD-12.2 What is the reason for using a speech processor with a single-sideband phone transmitter?

A. A properly adjusted speech processor reduces average transmitter power requirements
B. A properly adjusted speech processor reduces unwanted noise pickup from the microphone
C. A properly adjusted speech processor improves voice frequency fidelity
D. A properly adjusted speech processor improves signal intelligibility at the receiver

ANSWER D: All worldwide sets have a built-in speech processor section that may be switched on for long-range contacts. If it's properly adjusted, you will gain slight signal intelligibility at the *other station's* receiver. The thing to remember is that it improves reception at *his* receiver—not yours.

Speech Processor Waveforms

3BD-12.3 When a transmitter is 100% modulated, will a speech processor increase the output PEP?

A. Yes
B. No
C. It will decrease the transmitter's peak power output
D. It will decrease the transmitter's average power output

ANSWER B: Turning on your speech processor doesn't actually give you any greater power output. In some cases, it may slightly reduce power by lowering the peak, while simultaneously raising the average power of your transmitted signal.

3BD-12.4 Under which band conditions should a speech processor not be used?

A. When there is high atmospheric noise on the band
B. When the band is crowded
C. When the frequency in use is clear
D. When the sunspot count is relatively high

ANSWER C: Use the speech processor sparingly. It causes a very fat signal that may sometimes splatter. When signal conditions are good, switch it off for a more natural sounding voice.

3BD-12.5 What effect can result from using a speech processor with a single-sideband phone transmitter?

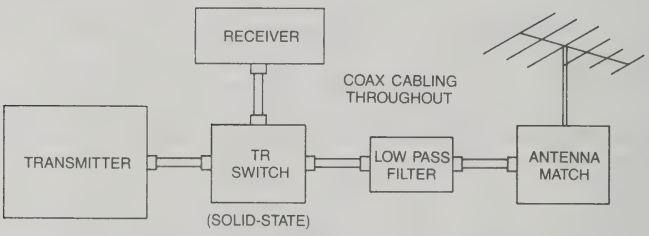
A. A properly adjusted speech processor reduces average transmitter power requirements
B. A properly adjusted speech processor reduces unwanted noise pickup from the microphone
C. A properly adjusted speech processor improves voice frequency fidelity
D. A properly adjusted speech processor improves signal intelligibility at the receiver

ANSWER D: Once again, when the speech processor has been adjusted properly, it will give you better signal intelligibility at the other person's receiver.

3BD-13.1 At what point in a coaxial line should an electronic T-R switch be installed?

A. Between the transmitter and low-pass filter
B. Between the low-pass filter and antenna
C. At the antenna feed point
D. Right after the low-pass filter

ANSWER A: Today's modern HF transceiver may not use a big relay to switch the antenna circuit from transmit to receive. Push the mike a couple of times and listen for a relay clicking. Most modern sets use a solid-state switching device that is incredibly fast, efficient, and silent. However, these new electronhic T-R switches might generate harmonics, so it's always a good idea to run an external low-pass filter on the outside of your set to make sure that harmonics are kept down to a minimum because of the electronic T-R switching.



TR Switch Installation

3BD-13.2 Why is an electronic T-R switch preferable to a mechanical one?

A. Greater receiver sensitivity
B. Circuit simplicity
C. Higher operating speed
D. Cleaner output signals

ANSWER C: If you are into computers, you need fast switching time between transmit and receive. The electronic T-R switch will do just that. For you mariners, the electronic T-R switch won't become fouled in the marine air. Conventional relays many times become corroded and will give intermittent contact until they have been cycled-through several times.

3BD-13.3 What station accessory facilitates QSK operation?

A. Oscilloscope
B. Audio CW filter
C. Antenna relay
D. Electronic TR switch

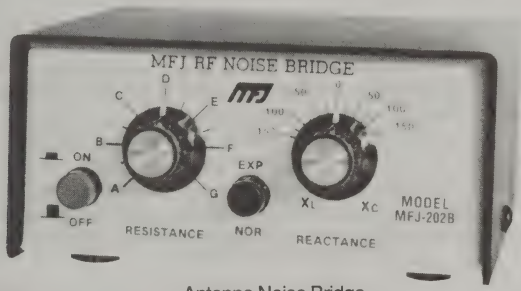
ANSWER D: The electronic T-R Switch allows an operator to instantly receive in between dots and dashes in full break-in telegraphy use. This is abbreviated QSK. If you send high-speed CW, it's always nice to hear what's going on behind your signals in between every dit and dah.

3BD-14.6 What is an antenna noise bridge?

A. An instrument for measuring the noise figure of an antenna or other electrical circuit

B. An instrument for measuring the impedance of an antenna or other electrical circuit
C. An instrument for measuring solar flux
D. An instrument for tuning out noise in a receiver

ANSWER B: This is an excellent accessory item for checking out your new worldwide antenna system without actually running your radio power into it. This device is like a mini-transmitter—it emits a low power signal between 1 MHz and 30 MHz. It has a small calibrated dial that lets you get in the ballpark of the test frequency for the antenna. When you hit the resonant frequency of the antenna, the needle will quickly deflect, and you know whether or not your antenna construction efforts were worthwhile! You also can calculate the antenna impedance by small adjustments to this bridge to see whether or not a mismatched antenna is simply too long, too short, or has the wrong impedance.



Antenna Noise Bridge
Courtesy of MFJ Enterprises, Inc.

3BD-14.7 How is an antenna noise bridge used?

A. It is connected at the antenna feed point, and the noise is read directly
B. It is connected between a transmitter and an antenna and tuned for minimum SWR
C. It is connected between a receiver and an unknown impedance and tuned for minimum noise
D. It is connected between an antenna and a Transmatch and adjusted for minimum SWR

ANSWER C: You also may use this noise bridge with an unknown impedance between your Amateur Radio receiver and an antenna system. Read the instructions carefully to see exactly how this piece of test equipment may be used for your particular installation.

3BD-15.1 How does the emitted waveform from a properly-adjusted single-sideband phone transmitter appear on a monitoring oscilloscope?

A. A vertical line
B. A waveform that mirrors the input waveform
C. A square wave
D. Two loops at right angles

ANSWER B: Back to the oscilloscope. You should be able to move your pick-up points from input to output on the transmitter, and the waveforms should be identical. You may have to adjust the amplifier controls on the oscilloscope to adjust for different signal levels, but the waveform shape should be the same.

3BD-15.2 What is the best instrument for checking transmitted signal quality from a CW or single-sideband phone transmitter?

A. A monitor oscilloscope
B. A field strength meter
C. A sidetone monitor
D. A diode probe and an audio amplifier

ANSWER A: Here we go again—your oscilloscope is always the best answer for the best instrument.

3BD-15.3 What is a monitoring oscilloscope?

A. A device used by the FCC to detect out-of-band signals
B. A device used to observe the waveform of a transmitted signal
C. A device used to display SSTV signals
D. A device used to display signals in a receiver IF stage

ANSWER B: Everytime you see the word oscilloscope, look for an answer with "waveform" in it. That's what an oscilloscope measures best.

3BD-15.4 How is a monitoring oscilloscope connected in a station in order to check the quality of the transmitted signal?

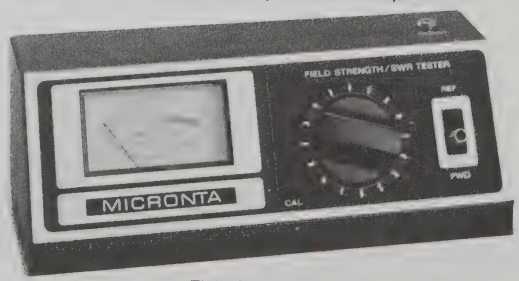
A. Connect the receiver IF output to the vertical-deflection plates of the oscilloscope
B. Connect the transmitter audio input to the oscilloscope vertical input
C. Connect a receiving antenna directly to the oscilloscope vertical input
D. Connect the transmitter output to the vertical-deflection plates of the oscilloscope

ANSWER D: If you connect your oscilloscope vertical-deflection plates to your transmitter, you will see the amplitude (height) of the signal vary as you talk into the microphone. This allows you to study carefully your transmitted waveform.

3BD-17.2 What is the most appropriate instrument to use when determining antenna horizontal radiation patterns?

A. A field-strength meter
B. A grid-dip meter
C. A wave meter
D. A vacuum-tube voltmeter

ANSWER A: The field-strength meter is a handy device to check relative power output. It detects the strength of the radiated signal. The field-strength meter is also good to sniff out transmitters stuck on the air. As soon as there is a good amount of power around, the meter will indicate the presence of rf power.



Field-Strength Meter

3BD-17.3 What is a field-strength meter?

A. A device for determining the standing-wave ratio on a transmission line
B. A device for checking modulation on the output of a transmitter
C. A device for monitoring relative RF output
D. A device for increasing the average transmitter output

ANSWER C: You can buy these devices at any Radio Shack store or CB radio shop, and they are handy on just about any frequency.

3BD-17.4 What is a simple instrument that can be useful for monitoring relative rf output during antenna and transmitter adjustments?

A. A field-strength meter
B. An antenna noise bridge
C. A multimeter
D. A Transmatch

ANSWER A: Every ham should own a field-strength meter.

3BD-17.5 When the power output from a transmitter is increased by four times, how should the S-meter reading on a nearby receiver change?

A. Decrease by approximately one S-unit
B. Increase by approximately one S-unit
C. Increase by approximately four S-units
D. Decrease by approximately four S-units

ANSWER B: Shown is the way the dB system works.

0 dB = 0 times change
3 dB = 2 times change
6 dB = 4 times change
9 dB = 8 times change
10 dB = 10 times change

If you double your power output, that is a 3 dB increase; if you cut your power in half, that's a 3 dB decrease. If you increase your output power by four times, that is a 6 dB increase, but only yields one additional S-unit on the other person's calibrated S-meter. That's right, four times change, 6 dB, is only one little S-unit!

3BD-17.6 By how many times must the power output from a transmitter be increased to raise the S-meter reading on a nearby receiver from S-8 to S-9?

A. Approximately 2 times
B. Approximately 3 times
C. Approximately 4 times
D. Approximately 5 times

ANSWER C: Since one S-unit was gained, it is a 4 times increase in power, or 6 dB.

Subelement 3BE – Electrical Principles (2 examination questions from 41 questions in 3BE)

3BE-1.1 What is meant by the term impedance?

A. The electric charge stored by a capacitor
B. The opposition to the flow of ac in a circuit containing only capacitance
C. The opposition to the flow of ac in a circuit
D. The force of repulsion presented to an electric field by another field with the same charge

ANSWER C: The term impedance means the opposition to the flow of alternating current in a circuit. You can create impedance to ac by winding a wire around a pencil and creating a coil. This handy "choke" would allow you to power your small handheld transceiver off of a 12-volt car system, and also offer impedance to ac signals generated by alternator whine coming down the line.

3BE-1.2 What is the opposition to the flow of ac in a circuit containing both resistance and reactance called?

A. Ohm
B. Joule
C. Impedance
D. Watt

ANSWER C: A coil (like the one used in question 3BE-1.1) has reactance and resistance. Reactance varies with frequency, resistance does not. Impedance is the combination of resistance and reactance. It opposes the flow of ac.

3BE-3.1 What is meant by the term reactance?

A. Opposition to dc caused by resistors
B. Opposition to ac caused by inductors and capacitors
C. A property of ideal resistors in ac circuits
D. A large spark produced at switch contacts when an inductor is de-energized

ANSWER B: A coil has inductive reactance; a capacitor has capacitive reactance. Both reactances vary with frequency.

3BE-3.2 What is the opposition to the flow of ac caused by an inductor called?

A. Resistance
B. Reluctance
C. Admittance
D. Reactance

ANSWER D: Think of an inductor as a coil of wire. It has inductive reactance identified as X_L. $X_L = 2\pi fL$, where L is the coil inductance. X_L increases as frequency increases.

3BE-3.3 What is the opposition to the flow of ac caused by a capacitor called?

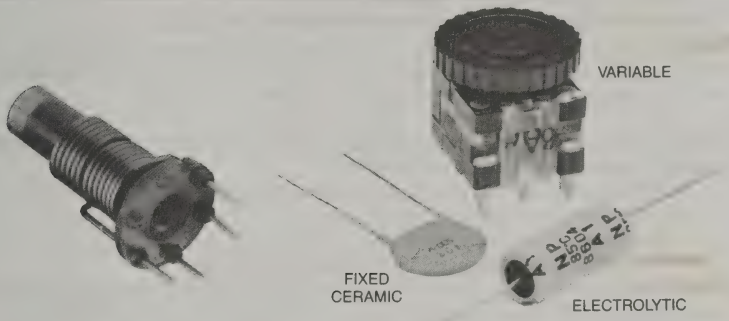
A. Resistance
B. Reluctance
C. Admittance
D. Reactance

ANSWER D: A capacitor has plates separated by an insulating dielectric. It has capacitive reactance identified as X_C. $X_C = 1/2\pi fC$ where C is the capacitance of the capacitor. X_C decreases as frequency increases.

3BE-3.4 How does a coil react to ac?

A. As the frequency of the applied ac increases, the reactance decreases.
B. As the amplitude of the applied ac increases, the reactance also increases.
C. As the amplitude of the applied ac increases, the reactance decreases.
D. As the frequency of the applied ac increases, the reactance also increases.

ANSWER D: Coils are quite effective in reducing alternator whine which is ac on a normally dc automobile circuit. The higher the alternator whine frequency, the greater the reactance from the coil.



Inductor Capacitors

3BE-3.5 How does a capacitor react to ac?

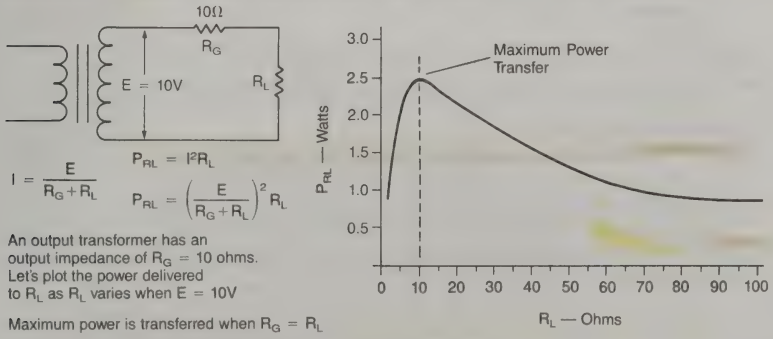
A. As the frequency of the applied ac increases, the reactance decreases
B. As the frequency of the applied ac increases, the reactance increases
C. As the amplitude of the applied ac increases, the reactance also increases
D. As the amplitude of the applied ac increases, the reactance decreases

ANSWER A: Capacitors offer reactance to ac inversely proportional to the frequency. Capacitors work better at lower frequencies than coils in opposing ac.

3BE-6.1 When will a power source deliver maximum output?

A. When the impedance of the load is equal to the impedance of the source
B. When the SWR has reached a maximum value
C. When the power supply fuse rating equals the primary winding current
D. When air wound transformers are used instead of iron core transformers

ANSWER A: When we match impedances, we have maximum capability for a power transfer. This is why it's important to always insure the antenna impedance matches that of your Amateur Radio transceiver which is rated at 50 ohms impedance.



Maximum Power Transfer

3BE-6.2 What is meant by impedance matching?

A. To make the load impedance much greater than the source impedance
B. To make the load impedance much less than the source impedance
C. To use a balun at the antenna feed point
D. To make the load impedance equal the source impedance

ANSWER D: If you connect a 50-ohm ham set to a 50-ohm antenna using 75-ohm coax cable (for television use), you will have an impedance mismatch. You will not get full power transfer. It is important to have 50 ohms throughout.

3BE-6.3 What occurs when the impedance of an electrical load is equal to the internal impedance of the power source?

A. The source delivers minimum power to the load.
B. There will be a high SWR condition.
C. No current can flow through the circuit.
D. The source delivers maximum power to the load.

ANSWER D: Always make sure your impedances are around 50 ohms for maximum power transfer. If there are mismatches, you must use impedance matching devices.

3BE-6.4 Why is impedance matching important in radio work?

A. So the source can deliver maximum power to the load
B. So the load will draw minimum power from the source
C. To ensure that there is less resistance than reactance in the circuit
D. To ensure that the resistance and reactance in the circuit are equal

ANSWER A: It's important that all impedances match for maximum power output.

3BE-7.2 What is the unit measurement of reactance?

A. Mho
B. Ohm
C. Ampere
D. Siemen

ANSWER B: The ohm is the unit of measurement used for reactance.

3BE-7.4 What is the unit measurement of impedance?

A. Ohm
B. Volt
C. Ampere
D. Watt

ANSWER A: The ohm also is used for measuring impedance. Thus, the ohm may mean impedance, reactance, or simply resistance.

3BE-10.1 What is a bel?

A. The basic unit used to describe a change in power levels
B. The basic unit used to describe a change in inductances
C. The basic unit used to describe a change in capacitances
D. The basic unit used to describe a change in resistances

ANSWER A: The bel is used to describe a change in power levels. It is a measure of the ratio of power output to power input.

If $dB = 10 \log_{10} \frac{P_1}{P_2}$

then what power ratio is 20 dB?

$$20 = 10 \log_{10} \frac{P_1}{P_2}$$

$$\frac{20}{10} = \log_{10} \frac{P_1}{P_2}$$

$$2 = \log_{10} \frac{P_1}{P_2}$$

Remember: logarithm of a number is the exponent to which the base must be raised to get the number.

$$\therefore 10^2 = \frac{P_1}{P_2}$$

$$100 = \frac{P_1}{P_2}$$

Or $P_1 = 100\ P_2$

20 dB means P_1 is 100 times P_2

dB	$\frac{P_1}{P_2}$
3	2
6	4
10	10
20	100
30	1000
40	10000
50	10^5
60	10^6

Definition of a Decibel

Source: *The Technology Dictionary*, © 1987 Master Publishing, Inc., Richardson, Texas

3BE-10.2 What is a decibel?

A. A unit used to describe a change in power levels, equal to 0.1 bel
B. A unit used to describe a change in power levels, equal to 0.01 bel
C. A unit used to describe a change in power levels, equal to 10 bels
D. A unit used to describe a change in power levels, equal to 100 bels

ANSWER A: One decibel (0.1 bel) is the very slightest change that can be detected in audio loudness. 3 dB is twice as loud, and 10 dB is ten times as loud. It is a logrithmic unit.

3BE-10.3 Under ideal conditions, a barely detectable change in loudness is approximately how many dB?

A. 12 dB
B. 6 dB
C. 3 dB
D. 1 dB

ANSWER D.

3BE-10.4 A two-times increase in power results in a change of how many dB?

A. Multiplying the original power by 2 gives a new power that is 1 dB higher.
B. Multiplying the original power by 2 gives a new power that is 3 dB higher.
C. Multiplying the original power by 2 gives a new power that is 6 dB higher.
D. Multiplying the original power by 2 gives a new power that is 12 dB higher.

ANSWER B: Remember, anything twice or half is always 3 dB. How many dB for one S-unit change? That's right—6, or a four times change.

3BE-10.5 An increase of 6 dB results from raising the power by how many times?

A. Multiply the original power by 1.5 to get the new power.
B. Multiply the original power by 2 to get the new power.
C. Multiply the original power by 3 to get the new power.
D. Multiply the original power by 4 to get the new power.

ANSWER D: 6 dB is equal to one single S-unit, a four times change.

3BE-10.6 A decrease of 3 dB results from lowering the power by how many times?

A. Divide the original power by 1.5 to get the new power.
B. Divide the original power by 2 to get the new power.
C. Divide the original power by 3 to get the new power.
D. Divide the original power by 4 to get the new power.

ANSWER B: A decrease of 3 dB results in one-half the original power level.

3BE-10.7 A signal strength report is "10 dB over S9." If the transmitter power is reduced from 1500 watts to 150 watts, what should be the new signal strength report?

A. S5
B. S7
C. S9
D. S9 plus 5 dB

ANSWER C: In this question, the power is reduced by 10 times. A 10 times change is equal to 10 dB. If the original signal was 10 dB over S9, the new signal is simply S9.

3BE-10.8 A signal strength report is "20 dB over S9." If the transmitter power is reduced from 1500 watts to 150 watts, what should be the new signal strength report?

A. S5
B. S7
C. S9
D. S9 plus 10 dB

ANSWER D: If the original signal was 20 dB over S9, and the power is reduced 10 times or 10 dB, the new signal will be 10 dB over S9.

3BE-10.9 A signal strength report is "20 dB over S9." If the transmitter power is reduced from 1500 watts to 15 watts, what should be the new signal strength report?

A. S5
B. S7
C. S9
D. S9 plus 10 dB

ANSWER C: Going from 1500 watts down to 15 watts is a reduction of 100 times in power level or 20 dB. As a result, the 20 dB signal over S9 will end up S9.

3BE-12.1 If a 1.0 ampere current source is connected to two parallel-connected 10-ohm resistors, how much current passes through each resistor?

A. 10 amperes
B. 2 amperes
C. 1 ampere
D. 0.5 ampere

ANSWER D: Since the two resistors are of equal value, the current divides equally between them so each passes 0.5 ampere. In a parallel circuit, the sum of the individual branch currents equals the source current.

3BE-12.3 In a parallel circuit with a voltage source and several branch resistors, what relationship does the total current have to the current in the branch circuits?

A. The total current equals the average of the branch current through each resistor.
B. The total current equals the sum of the branch current through each resistor.
C. The total current decreases as more parallel resistors are added to the circuit.
D. The total current is calculated by adding the voltage drops across each resistor and multiplying the sum by the total number of all circuit resistors.

ANSWER B: If you add up the current in each branch resistance, you will come up with the total current in the circuit.

3BE-13.1 How many watts of electrical power are being used when a 400-VAC power source supplies an 800-ohm load?

A. 0.5 watt
B. 200 watts
C. 400 watts
D. 320,000 watts

ANSWER B: The equation for this problem is $P = E^2/R$. 400 squared is 160,000. That divided by R (800) is 200, so the answer is 200 watts. Calculator keystrokes are: Clear, 400 × 400 ÷ 800 = 200.

3BE-13.2 How many watts of electrical power are being consumed by a 12-VAC pilot light which draws 0.2 amperes?

A. 60 watts
B. 24 watts WRONG DECIMAL 12 X .2 = 2.4
C. 6 watts
→D. 2.4 watts CORRECT

ANSWER D: Easy equation—power is equal to voltage times current (P = E × I). Simply multiply volts times amps and you end up with 2.4 watts. Remember the magic circle shown for power, P = E/I. Put your finger over P and it's equal to E × I.

P = POWER IN WATTS
E = VOLTAGE IN VOLTS
I = CURRENT IN AMPERES
R = RESISTANCE IN OHMS

Power Calculation

3BE-13.3 How many watts are being dissipated when 7.0 milliamperes flows through 1.25 kilohms?

A. Approximately 61 milliwatts
B. Approximately 39 milliwatts
C. Approximately 11 milliwatts
D. Approximately 9 milliwatts

ANSWER A: Use the equation $P = I^2 \times R$. Your answer will come out 0.061 watts. This is converted to 61 milliwatts by moving the decimal point three places to the right. A variation of the power magic circle is $P = I^2R$. It also is useful as a reminder.

3BE-14.1 How is the total resistance calculated for several resistors in series?

A. The total resistance must be divided by the number of resistors to ensure accurate measurement of resistance.
B. The total resistance is always the lowest-rated resistance.
C. The total resistance is found by adding the individual resistances together.
D. The tolerance of each resistor must be raised proportionally to the number of resistors.

ANSWER C: To find the total resistance when resistors are in series, simply add all resistances together ($R_T = R_1 + R_2 + R_3$).

3BE-14.2 What is the total resistance of two equal, parallel-connected resistors?

A. Twice the resistance of either resistance
B. The sum of the two resistances
C. The total resistance cannot be determined without knowing the exact resistances
D. Half the resistance of either resistor

ANSWER D: For two equal value parallel connected resistors, the total resistance is simply half the value of one of the resistors. These equations will help:

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}. \text{ If } R_1 = R_2, R_T = \frac{R_2^2}{2R_2} = \frac{R_2}{2}$$

3BE-14.3 What is the total inductance of two equal, parallel-connected inductors?

A. Half the inductance of either inductor, assuming no mutual coupling
B. Twice the inductance of either inductor, assuming no mutual coupling
C. The sum of the two inductances, assuming no mutual coupling
D. The total inductance cannot be determined without knowing the exact inductances.

ANSWER A: Total inductance is calculated for series or parallel connected coils exactly the same as series or parallel connected resistors, respectively. These equations show the similarity for parallel connected inductors without mutual coupling:

$$L_T = \frac{L_1 L_2}{L_1 + L_2}. \text{ If } L_1 = L_2, L_T = \frac{L_2^2}{2L_2} = \frac{L_2}{2}$$

3BE-14.4 What is the total capacitance of two equal, parallel-connected capacitors?

A. Half the capacitance of either capacitor
B. Twice the capacitance of either capacitor
C. The value of either capacitor
D. The total capacitance cannot be determined without knowing the exact capacitances.

ANSWER B: The capacitance of capacitors in parallel add, which is the opposite of resistors. Two parallel connected capacitors, with equal value, end up as twice the capacitance of either capacitor.

$$C_T = C_1 + C_2.$$

3BE-14.5 What is the total resistance of two equal, series-connected resistors?

A. Half the resistance of either resistor
B. Twice the resistance of either resistor
C. The value of either resistor
D. The total resistance cannot be determined without knowing the exact resistances.

ANSWER B: The resistance of resistors in series add so two equal value series connected resistors have twice the resistance of either resistor. These equations should help you remember:

$$R_T = R_1 + R_2. \text{ If } R_1 = R_2, R_T = 2R_2 = 2R_1$$

3BE-14.6 What is the total inductance of two equal, series-connected inductors?

A. Half the inductance of either inductor, assuming no mutual coupling
B. Twice the inductance of either inductor, assuming no mutual coupling
C. The value of either inductor, assuming no mutual coupling
D. The total inductance cannot be determined without knowing the exact inductances

ANSWER B: Since resistance and inductance are treated the same, the series combination has twice the inductance. Equations are:

$$L_T = L_1 + L_2. \text{ If } L_1 = L_2, L_T = 2L_2 = 2L_1 \text{ (no mutual coupling)}$$

3BE-14.7 What is the total capacitance of two equal, series-connected capacitors?

A. Half the capacitance of either capacitor
B. Twice the capacitance of either capacitor
C. The value of either capacitor
D. The total capacitance cannot be determined without knowing the exact capabilities

ANSWER A: For two equal value series connected capacitors, the total capacitance is simply half the capacitance of either capacitor. These equations should help:

$$C_T = \frac{C_1 C_2}{C_1 + C_2}. \text{ If } C_1 = C_2, C_T = \frac{C_2^2}{2C_2} = \frac{C_2}{2}$$

3BE-15.1 What is the voltage across a 500-turn secondary winding in a transformer when the 2250-turn primary is connected to 117 VAC?

A. 2369 volts
B. 526.5 volts
C. 26 volts
D. 5.8 volts

ANSWER C: This is a turns ratio problem, and is relatively easy to solve using the following equation:

$$E_S = E_P \times \frac{N_S}{N_P} = \frac{E_P \times N_S}{N_P}$$

which means the voltage of the secondary is equal to the voltage of the primary times the number of turns of the secondary divided by the number of turns of the primary. It is derived from the equation that says that the ratio of the secondary voltage, E_S, to the primary voltage, E_P, is equal to the ratio of the turns on the secondary, N_S, to the turns on the primary, N_P.

$$\frac{E_S}{E_P} = \frac{N_S}{N_P}$$

Multiply 117 times 500, and then divide your answer by 2250. This gives you 26 volts. Calculator keystrokes are: Clear, 117 × 500 ÷ 2250 = 26.

3BE-15.2 What is the turns ratio of a transformer to match an audio amplifier having an output impedance of 200 ohms to a speaker having an impedance of 10 ohms?

A. 4.47 to 1
B. 14.14 to 1
C. 20 to 1
D. 400 to 1

ANSWER A: The equation that applies is:

$$\frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$

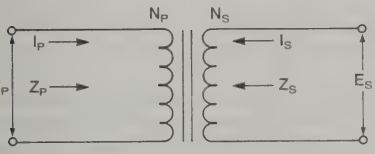
The ratio of the turns on the *primary*, N_P, to the turns on the *secondary*, N_S, is equal to the square root of the ratio of the primary impedance, Z_P, to the secondary impedance, Z_S. Remember that this turns ratio is primary to secondary. The ratio in question 3BE-15.1 is secondary to primary.

Don't worry if you have forgotten about square roots. There's an easy way to resolve the problem. The primary impedance of the transformer must match the 200-ohms output impedance of the amplifier; therefore, it is 200 ohms. Divide 200 ohms by 10 ohms, the speaker load impedance on the secondary, and you end up with 20.

Now you need to find the square root of 20. You know that a square root multiplied by itself gives you the number you want. You can do it by approximation. Since 5 × 5 = 25 and 4 × 4 = 16, you know that the square root of 20 is between 4 and 5. The only answer given that is close is 4.47. Choose it and you have the correct answer. See, you didn't have to remember how to do square roots.

The calculator keystrokes are: Clear, 200 ÷ 10 = 20, then press the square root key to produce the answer, 4.47.

Here is a summary of basic equations for transformers:



$$\frac{E_S}{E_P} = \frac{N_S}{N_P}$$ Turns ratio of secondary in relation to primary.

$$E_S = E_P\left(\frac{N_S}{N_P}\right)$$

In a transformer that has no loss $P_S = P_P$. All power applied to primary is delivered to secondary.

$$\therefore E_P I_P = E_S I_S$$

$$\text{or } \frac{E_S}{E_P} = \frac{I_P}{I_S} = \frac{N_S}{N_P}$$

$$\text{or } I_P = I_S\left(\frac{N_S}{N_P}\right)$$

A transformer is used to match impedance.

Since $E_P I_P = E_S I_S$ and

$E_P = Z_P I_P$ and $E_S = Z_S I_S$

$$\therefore Z_P I_P I_P = Z_S I_S I_S$$

$$\text{or } Z_P I_P^2 = Z_S I_S^2$$

$$\therefore \frac{Z_P}{Z_S} = \left(\frac{I_S}{I_P}\right)^2 = \left(\frac{N_P}{N_S}\right)^2$$

$$\text{or } \frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$

Transformer Basics

3BE-15.3 What is the turns ratio of a transformer to match an audio amplifier having an output impedance of 600 ohms to a speaker having an impedance of 4 ohms?

A. 12.2 to 1
B. 24.4 to 1
C. 150 to 1
D. 300 to 1

ANSWER A: Same equation here, $N_P/N_S = \sqrt{Z_P/Z_S}$, divide 4 into 600 and you end up with 150. Now find the square root of 150 again by approximation. Since 12×12 equals 144, chances are 12.2 is close enough. That's the correct answer. Remember, turns ratio in this case is turns of primary, N_P, to turns of secondary, N_S. The calculator keystrokes are: Clear, 600 ÷ 4 = 150 then press the square root key to produce the answer, 12.25.

3BE-15.4 What is the impedance of a speaker which requires a transformer with a turns ratio of 24 to 1 to match an audio amplifier having an output impedance of 2000 ohms?

A. 576 ohms
B. 83.3 ohms
C. 7.0 ohms
D. 3.5 ohms

ANSWER D: Now you use the equation of question 3BE-15.2 a little differently. If you square the turns ratio N_P/N_S you get:

$$\left(\frac{N_P}{N_S}\right)^2 = \frac{Z_P}{Z_S} \text{ and } Z_S = \frac{Z_P}{T^2}$$

where T^2 is the square of primary to secondary turns ratio. The impedance of the secondary is equal to the impedance of the primary divided by the turns ratio squared. For this case:

$$Z_S = \frac{2000}{24^2} = \frac{2000}{576} = 3.47$$

As worked out, you see you end up with about 3.5 ohms. Aren't most speakers around 3 or 4 ohms? Have you ever seen a speaker that has impedances like 576 ohms, or 83 ohms? Probably not—so you should immediately spot 3.5 ohms as the likely correct answer because that's what most speakers are! Maybe you didn't need to do all the calculations. Think it through! The odd-ball 7 ohms is temptingly close to 8 ohms, a common speaker impedance; so be careful of it.

3BE-16.1 What is the voltage that would produce the same amount of heat over time in a resistive element as would an applied sine wave ac voltage?

A. A dc voltage equal to the peak-to-peak value of the ac voltage
B. A dc voltage equal to the RMS value of the ac voltage
C. A dc voltage equal to the average value of the ac voltage
D. A dc voltage equal to the peak value of the ac voltage

ANSWER B: The root mean square (RMS) voltage is the effective value of an ac voltage. The effective value of a sine wave voltage is the equivalent dc voltage value asked for in the question. To calculate peak value of a sine wave voltage, multiply the effective value by 1.414. To calculate the effective voltage from a peak voltage, multiply the peak voltage by 0.707.

$$E_{RMS} = 0.707\ E_{PK}$$
$$E_{PK} = \frac{E_{RMS}}{0.707}$$
$$E_{PK} = 1.414\ E_{RMS}$$
$$E_{PP} = 2\ E_{PK}$$
$$E_{PK} = \frac{E_{PP}}{2}$$

Basic AC Voltage Equations

3BE-16.2 What is the peak-to-peak voltage of a sine wave which has an RMS voltage of 117 volts?

A. 82.7 volts
B. 165.5 volts
C. 183.9 volts
D. 330.9 volts

ANSWER D: This is a tricky question. First calculate peak voltage of the 117 volts RMS by multiplying 117 times 1.414. They want to know peak-to-peak voltage, so multiply your answer by 2. You should come up with around 330.9 volts. The key here is peak-to-peak, not just peak voltage. The calculator keystrokes are: Clear, $117 \times 1.414 \times 2 = 330.88$.

3BE-16.3 A sine wave of 17 volts peak is equivalent to how many volts RMS?

A. 8.5 volts
B. 12 volts
C. 24 volts
D. 34 volts

ANSWER B: Here we have an ac voltage of 17 volts peak. Multiply 17 times 0.707 to obtain the RMS voltage of 12 volts. The calculator keystrokes are: Clear, 17 × 0.707 = 12.02.

Subelement 3BF – Circuit Components (1 examination question from 11 questions in 3BF)

3BF-1.5 What is the effect of an increase in ambient temperature on the resistance of a carbon resistor?

A. The resistance will increase by 20% for every 10 degrees centigrade that the temperature increases.
B. The resistance stays the same.
C. The resistance change depends on the resistor's temperature coefficient rating.
D. The resistance becomes time dependent.

ANSWER C: Heating a carbon resistor always increases its resistance. However, the amount of change for any particular temperature change depends on its temperature coefficient which depends on the materials used in its construction.

3BF-2.6 What type of capacitor is often used in power supply circuits to filter the rectified ac?

A. Disc ceramic
B. Vacuum variable
C. Mica
D. Electrolytic

ANSWER D: Rectified ac is a form of pulsating dc. Electrolytic capacitors usually are used because they offer large amounts of capacity in a small container. Their big problem is that they dry out after extended periods of time and lose their capacitance.

3BF-2.7 What type of capacitor is used in power supply circuits to filter transient voltage spikes across the transformer secondary winding?

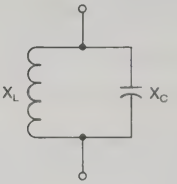
A. High-value
B. Trimmer
C. Vacuum variable
D. Suppressor

ANSWER D: Many power supply strips, especially designed for computers, contain suppressor capacitors to minimize transient voltage spikes. If you run a lot of ham radio computer equipment, be sure to buy the power strips designed especially for suppressing spikes.

3BF-3.5 How do inductors become self-resonant?

A. Through distributed electromagnetism
B. Through eddy currents
C. Through distributed capacitance
D. Through parasitic hysteresis

ANSWER C: An inductor is a coil of wire and a small amount of capacitance, called distributed capacitance, exists between each turn and an adjacent turn. This distributed capacity can resonate with the inductance at a certain frequency, called the self-resonant frequency.



$$X_L = 2\pi fL$$

$$X_C = \frac{1}{2\pi fC}$$

The resonant frequency of a circuit is

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

The resonant frequency is the frequency where $X_L = X_C$.

$$\therefore 2\pi fL = \frac{1}{2\pi fC}$$

$$f^2 = \frac{1}{(2\pi L)(2\pi C)}$$

$$f^2 = \frac{1}{(2\pi)^2 LC}$$

$$\therefore f_r = \frac{1}{2\pi\sqrt{LC}}$$

Resonant Frequency

3BF-4.1 What circuit component can change 120 VAC to 400 VAC?

A. A transformer
B. A capacitor
C. A diode
D. An SCR

ANSWER A: Transformers are used to change low voltages to high voltages and vice versa. In Amateur Radio applications, step-down transformers are used to convert 110 VAC to 12 VAC, which then is rectified and filtered to operate 12-VDC equipment from house power.

3BF-4.2 What is the source of energy connected to in a transformer?

A. To the secondary winding
B. To the primary winding
C. To the core
D. To the plates

ANSWER B: The primary winding goes to your home electricity. The load goes to the secondary winding.

3BF-4.3 When there is no load attached to the secondary winding of a transformer, what is current in the primary winding called?

A. Magnetizing current
B. Direct current
C. Excitation current
D. Stabilizing current

ANSWER A: Never put a computer disk or tape cassette on top of a power supply. Power supplies usually contain a large transformer, and transformers radiate a magnetic field due to the magnetizing current. This magnetizing current is very strong, and if the shielding around the transformer is not sufficient, the magnetic field can destroy the information on your disk or cassette.

3BF-4.4 In what terms are the primary and secondary windings ratings of a power transformer usually specified?

A. Joules per second
B. Peak inverse voltage
C. Coulombs per second
D. Volts or volt-amperes

ANSWER D: When looking for a power supply or power supply transformer, you need to know how many volts you want, and how many amps of load you need to supply. The product of the two is the volt-amp rating, or simply volt-amps. Most ham radio power supplies are rated at 12 volts output supplying 20 to 35 amps. Volt-ampere equals volts × amperes. A 12V at 20A transformer is a 240-VA transformer.

3BF-5.1 What is the peak-inverse-voltage rating of a power supply rectifier?

A. The highest transient voltage the diode will handle
B. 1.4 times the ac frequency
C. The maximum voltage to be applied in the non-conducting direction
D. 2.8 times the ac frequency

ANSWER C: Your power supply uses rectifier diodes that block ac current from flowing in one direction. The peak inverse voltage (PIV) is a rating for maximum voltage that the diode is expected to block without failing.

3BF-5.2 Why must silicon rectifier diodes be thermally protected?

A. Because of their proximity to the power transformer
B. Because they will be destroyed if they become too hot
C. Because of their susceptibility to transient voltages
D. Because of their use in high-voltage applications

ANSWER B: If your power supply is getting hot, figure out a way to cool it. While rectifier diodes are thermally protected, too much heat can destroy them. Always keep your heat sinks clear so they can "breathe."

3BF-5.4 What are the two major ratings for silicon diode rectifiers of the type used in power supply circuits which must not be exceeded?

A. Peak load impedance; peak voltage
B. Average power; average voltage
C. Capacitive reactance; avalanche voltage
D. Peak inverse voltage; average forward current

ANSWER D: Excessive peak inverse voltage causes excessive leakage current and the diode gets hot. Excessive forward current causes the same thing—an increase in temperature.

Subelement 3BG – Practical Circuits (1 examination question out of 10 questions in 3BG)

3BG-1.1 Why should a resistor and capacitor be wired in parallel with power supply rectifier diodes?

A. To equalize voltage drops and guard against transient voltage spikes
B. To ensure that the current through each diode is about the same
C. To smooth the output waveform
D. To decrease the output voltage

ANSWER A: If you look into your transmitter's power supply, chances are you will find rectifier diodes, wired in a series string, with resistors and capacitors soldered in parallel across each diode. The capacitor and resistor combination protects the diodes from spikes and also helps equalize the slight voltage drop difference across each diode.

3BG-1.2 What function do capacitors serve when resistors and capacitors are connected in parallel with high-voltage power supply rectifier diodes?

A. They double or triple the output voltage.
B. They block the alternating current.
C. They protect those diodes that develop back resistance faster than other diodes.
D. They regulate the output voltage.

ANSWER C: Capacitors protect against transient voltage spikes which could make a diode fail, especially if it has begun to develop some reverse leakage current.

3BG-1.3 What is the output waveform of an unfiltered full-wave rectifier connected to a resistive load?

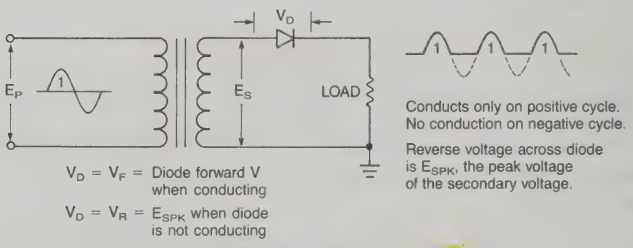
A. A steady dc voltage
B. A sine wave at half the frequency of the ac input
C. A series of pulses at the same frequency as the ac input
D. A series of pulses at twice the frequency of the ac input

ANSWER D: A full-wave rectifier gives a much smoother pulsating dc to filter than a half-wave rectifier because the full-wave rectifier doubles the line frequency.

3BG-1.4 How many degrees of each cycle does a half-wave rectifier utilize?

A. 90 degrees
B. 180 degrees
C. 270 degrees
D. 360 degrees

ANSWER B: The half-wave rectifier uses only half of a cycle which is 180 degrees.



Half-Wave Rectifier

3BG-1.5 How many degrees of each cycle does a full-wave rectifier utilize?

A. 90 degrees
B. 180 degrees
C. 270 degrees
D. 360 degrees

ANSWER D: Full-wave rectifiers are much more efficient because they use all 360 degrees. A full-wave rectifier output is also much easier to filter to provide pure dc voltage.

3BG-1.6 Where is a power supply bleeder resistor connected?

A. Across the filter capacitor
B. Across the power-supply input
C. Between the transformer primary and secondary
D. Across the inductor in the output filter

ANSWER A: All filter capacitors should always have a bleeder resistor for safety, and to assist in voltage regulation.

3BG-1.7 What components comprise a power supply filter network?

A. Diodes
B. Transformers and transistors
C. Quartz crystals
D. Capacitors and inductors

ANSWER D: In power supplies, transformers supply the voltage and current, diodes rectify, capacitors and inductors filter, and bleeder resistors protect.

3BG-1.8 What should be the peak-inverse-voltage rating of the rectifier in a full-wave power supply?

A. One-quarter the normal output voltage of the power supply
B. Half the normal output voltage of the power supply
C. Equal to the normal output voltage of the power supply
D. Double the normal peak output voltage of the power supply

ANSWER D: Double or nothing! The peak inverse voltage rating of rectifier diodes normally is doubled for a full-wave power supply. This is because the diode is "seeing" the entire secondary winding as opposed to just half of the secondary winding in the opposite direction. It's always a good idea to double the voltage rating of any type of capacitor or diode going into a power supply circuit.

3BG-1.9 What should be the peak-inverse-voltage rating of the rectifier in a half-wave power supply?

A. One-quarter to one-half the normal peak output voltage of the power supply
B. Half the normal output voltage of the power supply
C. Equal to the normal output voltage of the power supply
D. One to two times the normal peak output voltage of the power supply

ANSWER D: At least one time, but to be much more reliable, two times the peak voltage output.

3BG-2.8 What should the impedance of a low-pass filter be as compared to the impedance of the transmission line into which it is inserted?

A. Substantially higher
B. About the same
C. Substantially lower
D. Twice the transmission line impedance

ANSWER B: This question is a bit out of place—but as discussed earlier, impedances should always be the same for maximum transfer of power, so you want the low-pass filter to have the same impedance as the transmission line and ham transceiver between which it is inserted.

Subelement 3BH – Signals and Emissions (2 examination questions from 22 questions in 3BH)

3BH-2.1 What is the term for alteration of the amplitude of an rf wave for the purpose of conveying information?

A. Frequency modulation
B. Phase modulation
C. Amplitude rectification
D. Amplitude modulation

ANSWER D: If the amplitude is altered, it's amplitude modulation. This makes sense.

3BH-2.3 What is the term for alteration of the phase of an rf wave for the purpose of conveying information?

A. Pulse modulation
B. Phase modulation
C. Phase rectification
D. Amplitude modulation

ANSWER B: If the phase is altered, it's phase modulation. This makes sense.

3BH-2.4 What is the term for alteration of the frequency of an RF wave for the purpose of conveying information?

A. Phase rectification
B. Frequency rectification
C. Amplitude modulation
D. Frequency modulation

ANSWER D: If the frequency is altered, it's frequency modulation. Don't you think it makes sense?

3BH-3.1 In what emission type does the instantaneous amplitude (envelope) of the RF signal vary in accordance with the modulating AF?

A. Frequency shift keying
B. Pulse modulation
C. Frequency modulation
D. Amplitude modulation

ANSWER D: If the amplitude varies in accordance with the modulating audio frequency input, it is amplitude modulation.

3BH-3.2 What determines the spectrum space occupied by each group of sidebands generated by a correctly operating double-sideband phone transmitter?

A. The audio frequencies used to modulate the transmitter
B. The phase angle between the audio and radio frequencies being mixed
C. The radio frequencies used in the transmitter's VFO
D. The CW keying speed

ANSWER A: The sidebands generated by a double-sideband AM transmitter operating with phone will occupy the spectrum space with the audio frequencies used in the modulation circuitry up to about 3,000 cycles.

3BH-4.1 How much is the carrier suppressed in a single-sideband phone transmission?

A. No more than 20 dB below peak output power
B. No more than 30 dB below peak output power

C. At least 40 dB below peak output power
D. At least 60 dB below peak output power

ANSWER C: Life begins at 40! Carrier suppression of a single-sideband transmission is greater than 40 dB below the output power.

3BH-4.2 What is one advantage of carrier suppression in a double-sideband phone transmission?

A. Only half the bandwidth is required for the same information content.
B. Greater modulation percentage is obtainable with lower distortion.
C. More power can be put into the sidebands.
D. Simpler equipment can be used to receive a double-sideband suppressed-carrier signal.

ANSWER C: SSB is more efficient than double sideband because there is no power wasted in the carrier, nor any power wasted in one of the unnecessary sidebands.

3BH-5.1 Which one of the telephony emissions popular with amateurs occupies the narrowest band of frequencies?

A. Single-sideband emission
B. Double-sideband emission
C. Phase-modulated emission
D. Frequency-modulated emission

ANSWER A: Single sideband J3E is the more efficient communication hams have that only occupies 3 kHz of space.

3BH-5.2 Which emission type is produced by a telephony transmitter having a balanced modulator followed by a 2.5-kHz bandpass filter?

A. PM
B. AM
C. SSB
D. FM

ANSWER C: The 2.5-kHz bandpass filter is the give-away here. The 2.5-kHz bandpass filter singles out and filters the unwanted sideband.

3BH-7.2 What emission is produced by a reactance modulator connected to an RF power amplifier?

A. Multiplex modulation
B. Phase modulation
C. Amplitude modulation
D. Pulse modulation

ANSWER B: Anytime you see a reactance modulator, you can be sure the transmitter is a frequency-modulation or phase-modulation set. Reactance modulators are in all handie-talkie sets.

3BH-8.1 What purpose does the carrier serve in a double-sideband phone transmission?

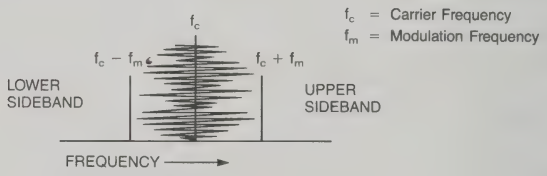
A. The carrier separates the sidebands so they don't cancel in the receiver.
B. The carrier contains the modulation information.
C. The carrier maintains symmetry of the sidebands to prevent distortion.
D. The carrier serves as a reference signal for demodulation by an envelope detector.

ANSWER D: Think of it this way—when you tune in an AM radio station on your car radio, the carrier is used as a reference signal for the center of the modulated emission. This cuts down the background hash and clarifies the incoming signals.

3BH-8.2 What signal component appears in the center of the frequency band of a double-sideband phone transmission?

A. The lower sidebands
B. The subcarrier
C. The carrier
D. The pilot tone

ANSWER C: On a double-sideband phone transmission, the carrier is right in the middle of the upper and lower sidebands.



Carrier and Sidebands of A3E Emission

3BH-9.1 What sidebands are generated by a double-sideband phone transmitter with a 7250-kHz carrier modulated less than 100% by an 800-Hz pure sine wave?

A. 7250.8 kHz and 7251.6 kHz
B. 7250.0 kHz and 7250.8 kHz
C. 7249.2 kHz and 7250.8 kHz
D. 7248.4 kHz and 7249.2 kHz

ANSWER C: Since you are broadcasting double sideband, your signal modulation drops down 0.8 kHz (800 Hz) below the carrier and extends up 0.8 kHz above the carrier.

3BH-10.1 How many times over the maximum deviation is the bandwidth of an FM-phone transmission?

A. 1.5
B. At least 2.0
C. At least 4.0
D. The bandwidth cannot be determined without knowing the exact carrier and modulating frequencies involved.

ANSWER B: When you operate an FM set, you always consider that your deviation is "plus or minus" 5 kHz. This is because you create multiple sidebands on either side of your center resting frequency.

3BH-10.2 What is the total bandwidth of an FM-phone transmission having 5-kHz deviation and a 3-kHz modulating frequency?

A. 3 kHz
B. 5 kHz
C. 8 kHz
D. 16 kHz

ANSWER D: You calculate this by multiplying 2 times the sum of the deviation and highest audio modulating frequency. Our deviation is 5 kHz plus 3 kHz of audio, which gives us a sum of 8 kHz. 8 kHz times 2 equals 16 kHz.

3BH-11.1 What happens to the shape of the RF envelope, as viewed on an oscilloscope, during double-sideband phone transmission?

A. The amplitude of the envelope increases and decreases in proportion to the modulating signal.
B. The amplitude of the envelope remains constant.
C. The brightness of the envelope increases and decreases in proportion to the modulating signal.
D. The frequency of the envelope increases and decreases in proportion to the amplitude of the modulating signal.

ANSWER A: We have been over it many times. AM varies the amplitude.

3BH-13.1 What results when a single-sideband phone transmitter is over-modulated?

A. The signal becomes louder with no other effects.
B. The signal occupies less bandwidth with poor high frequency response.
C. The signal has higher fidelity and improved signal-to-noise ratio.
D. The signal becomes distorted and occupies more bandwidth.

ANSWER D: Overmodulation in any type of transmitter will cause excessive bandwidth and probable splatter to adjacent frequencies.

3BH-13.2 What results when a double-sideband phone transmitter is over-modulated?

A. The signal becomes louder with no other effects.
B. The signal becomes distorted and occupies more bandwidth.
C. The signal occupies less bandwidth with poor high frequency response.
D. The transmitter's carrier frequency deviates.

ANSWER B: It's important never to operate with your mike gain higher than halfway up because it could lead to overmodulation.

3BH-15.1 What is the frequency deviation for a 12.21-MHz reactance-modulated oscillator in a 5-kHz deviation, 146.52-MHz, FM-phone transmitter?

A. 41.67 Hz
B. 416.7 Hz
C. 5 kHz
D. 12 kHz

ANSWER B: This is an easy ratio problem. First let's find out what the frequency multiplication factor is of the transmitter. Divide the 12.21 oscillator frequency into the output at 146.52. This gives a multiplication factor of 12. If there is 5 kHz deviation at the transmitter, 1/12th deviation at the oscillator input is 12 divided into 5000 Hz, with an answer of 416.66 Hz.

3BH-15.2 What stage in a transmitter would translate a 5.3-MHz input signal to 14.3 MHz?

A. A mixer
B. A beat frequency oscillator
C. A frequency multiplier
D. A linear translator stage

ANSWER A: While this may look like a simple frequency multiplier, you will see that 14.3 is not an exact multiple of 5.3. This means that you are *mixing* an additional stage to obtain 14.3, so your answer is "a mixer".

3BH-16.4 How many frequency components are in the signal from an AF shift keyer at any instant?

A. One
B. Two
C. Three
D. Four

ANSWER A: If you have ever listened to an RTTY signal, you will hear two distinct tones, but never on at the same time. Hint: there is only one tone at any one instant.

3BH-16.5 How is frequency shift related to keying speed in an fsk signal?

A. The frequency shift in hertz must be at least four times the keying speed in WPM.
B. The frequency shift must not exceed 15 Hz per WPM of keying speed.
C. Greater keying speeds require greater frequency shifts.
D. Greater keying speeds require smaller frequency shifts.

ANSWER C: The faster digital and code emissions are sent, the greater the bandwidth these emissions occupy.

Spacing	Mark	Space
170 Hz	2125 Hz	2295 Hz
170 Hz	1275 Hz	1445 Hz
200 Hz	1270 Hz	1070 Hz Originate
200 Hz	2225 Hz	2025 Hz Answer
425 Hz	2125 Hz	2550 Hz
850 Hz	2975 Hz	2125 Hz
850 Hz	1275 Hz*	2125 Hz

*British Standard, all others U.S. Standard.

Mark and Space Frequencies for FSK Spacing

Source: *Digital Communications with Packet Radio*, © 1988 Master Publishing, Inc., Richardson, Texas

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Subelement 3BI – Antennas and Feed Lines (4 examination questions from 41 questions in 3BI)

3BI-1.3 Why is a Yagi antenna often used for radio communications on the 20-meter band?

A. It provides excellent omnidirectional coverage in the horizontal plane.
B. It is smaller, less expensive and easier to erect than a dipole or vertical antenna.

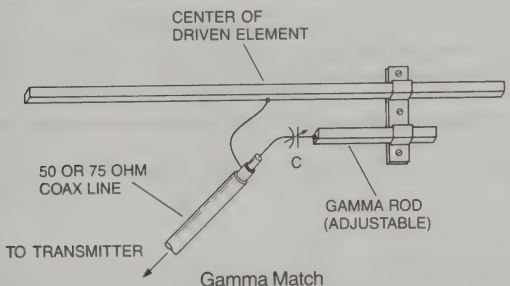
C. It discriminates against interference from other stations off to the side or behind.
D. It provides the highest possible angle of radiation for the HF bands.

ANSWER C: The Yagi antenna actually was invented by Professor Uda, but credited to a Japanese physicist, Yagi, because Yagi translated the idea to English. Professor Uda found that elements in front of, and in back of, a directly fed dipole would concentrate the energy in one direction. Yagis are used for long-distance communications on high frequency as well as VHF and UHF.

3BI-1.7 What method is best suited to match an unbalanced coaxial feed line to a Yagi antenna?

A. "T" match
B. Delta match
C. Hairpin match
D. Gamma match

ANSWER D: The gamma match is the most predictable way of feeding a Yagi antenna. It may be preset for a very close match once the antenna is up and in place.



Gamma Match

3BI-1.9 How can the bandwidth of a parasitic beam antenna be increased?

A. Use larger diameter elements
B. Use closer element spacing
C. Use traps on the elements
D. Use tapered-diameter elements

ANSWER A: The greater the diameter of the elements, the greater the bandwidth. This is why a wire beam antenna does not offer as much bandwidth as one constructed of large aluminum tubes.

3BI-2.1 How much gain over a half-wave dipole can a two-element cubical quad antenna provide?

A. Approximately 0.6 dB
B. Approximately 2 dB
C. Approximately 6 dB
D. Approximately 12 dB

ANSWER C: A simple 2-element cubical quad will give almost 6 dB, or 4 times the gain over a half-wave dipole.

3BI-3.1 How long is each side of a cubical quad antenna driven element for 21.4 MHz?

A. 1.17 feet
B. 11.7 feet
C. 47 feet
D. 469 feet

ANSWER B: Here is the calculation for determining one side of a 4-sided cubical quad driven element: 1005 divided by frequency in MHz equals *full* length in feet. Then divide your answer by 4 because you only want one side. (The 1005 is a factor for the velocity of RF in copper wire in feet, not meters.)(See Appendix for equation, pg. 101)

3BI-3.2 How long is each side of a cubical quad antenna driven element for 14.3 MHz?

A. 1.75 feet
B. 17.6 feet
C. 23.4 feet
D. 70.3 feet

ANSWER B: Same deal, same equation. Don't forget to divide by 4 because you only want one side. If you forget to divide by 4, they have an incorrect answer waiting for you! The calculator keystrokes are: Clear, 1005 ÷ 14.3 = 70.28 ÷ 4 = 17.57.

3BI-3.3 How long is each side of a cubical quad antenna reflector element for 29.6 MHz?

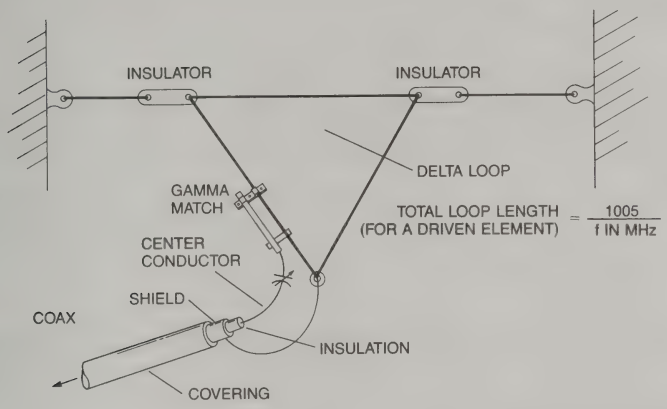
A. 8.23 feet
B. 8.7 feet
C. 9.7 feet
D. 34.8 feet

ANSWER B: Now they want the reflector element. This is a little bit longer, so the factor for velocity of RF in copper wire is now 1030 divided by the frequency in MHz. Don't forget to divide by 4 because you only want one side! The calculator keystrokes are: Clear, 1030 ÷ 29.6 = 34.79 ÷ 4 = 8.7. (See Appendix for equation, pg. 101)

3BI-3.4 How long is each leg of a symmetrical delta loop antenna driven element for 28.7 MHz?

A. 8.75 feet
B. 11.32 feet
C. 11.7 feet
D. 35 feet

ANSWER C: The delta loop is a triangle affair that is a full wavelength around. Use the same formula, 1005 divided by frequency in MHz, for the driven element, just as you did the cubical quad. However, since this is a delta loop, divide your answer by 3, instead of 4, for one side. Calculator keystrokes are: Clear, 1005 ÷ 28.7 = 35.02 ÷ 3 = 11.67. (See Appendix for equation, pg. 101)



Delta Loop

3BI-3.5 How long is each leg of a symmetrical delta loop antenna driven element for 24.9 MHz?

A. 10.09 feet
B. 13.05 feet
C. 13.45 feet
D. 40.36 feet

ANSWER C: Use the same formula here, and don't forget to divide by 3! A wrong answer is waiting for you if you don't. Calculator keystrokes are: Clear, 1005 ÷ 24.9 = 40.36 ÷ 3 = 13.45. (See Appendix for equation, pg. 101)

3BI-3.6 How long is each leg of a symmetrical delta loop antenna reflector element for 14.1 MHz?

A. 18.26 feet
B. 23.76 feet
C. 24.35 feet
D. 73.05 feet

ANSWER C: Now they want the reflector, so use the slightly larger number 1030 (see question 3I-3.3) divided by frequency in MHz. Hey, don't forget to divide by 3 because they only want one side! Calculator keystrokes are: Clear, 1030 ÷ 14.1 = 73.05 ÷ 3 = 24.35. (See Appendix for equation, pg. 101)

3BI-3.7 How long is the driven element of a Yagi antenna for 14.0 MHz?

A. Approximately 17 feet
B. Approximately 33 feet
C. Approximately 35 feet
D. Approximately 66 feet

ANSWER B: You use a different set of equations for the Yagi antenna. You are looking for the complete end-to-end driven element of a Yagi antenna for 14 MHz. It is given by:

$$\text{Driven Element} = \frac{\lambda}{2} = \frac{472}{\text{f in MHz}} \text{ ft.}$$

The factor 472 divided by the frequency in MHz gives the length in feet of the driven element. No further division is necessary because the equation is for the entire length of the driven element. The calculator keystrokes are: Clear, 472 ÷ 14 = 33.71.

3BI-3.8 How long is the director element of a Yagi antenna for 21.1 MHz?

A. Approximately 42 feet
B. Approximately 21 feet
C. Approximately 17 feet
D. Approximately 10.5 feet

ANSWER B: The director needs to be shorter, so use the factor 458 (substituted for 472 in the equation in question 3BI-3.7) divided by the frequency in MHz to get the answer. Calculator keystrokes are: Clear, 458 ÷ 21.1 = 21.70. (See Appendix for equation, pg. 101)

3BI-3.9 How long is the reflector element of a Yagi antenna for 28.1 MHz?

A. Approximately 8.75 feet
B. Approximately 16.6 feet
C. Approximately 17.5 feet
D. Approximately 35 feet

ANSWER C: The reflector must be a little bit longer, so now the equation factor is 490 (substituted for 472 in the equation in question 3I-3.7) and is divided by the frequency in MHz. The calculator keystrokes are: Clear, 490 ÷ 28.1 = 17.44. (See Appendix for equation, pg. 101)

3BI-5.1 What is the feed-point impedance for a half-wavelength dipole HF antenna suspended horizontally one-quarter wavelength or more above the ground?

A. Approximately 50 ohms, resistive
B. Approximately 73 ohms, resistive and inductive
C. Approximately 50 ohms, resistive and capacitive
D. Approximately 73 ohms, resistive

ANSWER D: Your dipole will work a lot better with a balun that matches its impedance of 73 ohms resistive to your transmission line impedance of 50 ohms.

3BI-5.2 What is the feed-point impedance of a quarter-wavelength vertical HF antenna with a horizontal ground plane?

A. Approximately 18 ohms
B. Approximately 36 ohms
C. Approximately 52 ohms
D. Approximately 72 ohms

ANSWER B: A quarter-wavelength vertical antenna with the ground plane exactly horizontal at its base is not a 50-ohm match! It's more like 36 ohms. This is why it's necessary to bend the radials down at about a 45-degree angle to bring the match up to about 50 ohms.

3BI-5.3 What is an advantage of downward sloping radials on a ground-plane antenna?

A. Sloping the radials downward lowers the radiation angle.
B. Sloping the radials downward brings the feed-point impedance close to 300 ohms.
C. Sloping the radials downward allows rainwater to run off the antenna.
D. Sloping the radials downward brings the feed-point impedance closer to 50 ohms.

ANSWER D: That's right, slope those radials down to raise the feedpoint impedance.

3BI-5.4 What happens to the feed-point impedance of a ground-plane antenna when the radials slope downward from the base of the antenna?

A. The feed-point impedance decreases.
B. The feed-point impedance increases.
C. The feed-point impedance stays the same.
D. The feed-point impedance becomes purely capacitive.

ANSWER B: This is why those ground planes are sometimes called "drooping ground planes."

3BI-6.1 Compared to a dipole antenna, what are the directional radiation characteristics of a cubical quad HF antenna?

A. The quad has more directivity in the horizontal plane but less directivity in the vertical plane.
B. The quad has less directivity in the horizontal plane but more directivity in the vertical plane.
C. The quad has more directivity in both horizontal and vertical planes.
D. The quad has less directivity in both horizontal and vertical planes.

ANSWER C: Quads are a little bit like a magnifying glass—they have a more concentrated pattern in both the horizontal and vertical planes than any other type of antenna system.

3BI-6.2 What is the radiation pattern of an ideal half-wavelength dipole HF antenna?

A. If it is installed parallel to the earth, it radiates well in a figure-eight pattern at right angles to the antenna wire.
B. If it is installed parallel to the earth, it radiates well in a figure-eight pattern off both ends of the antenna wire.
C. If it is installed parallel to the earth, it radiates equally well in all directions.
D. If it is installed parallel to the earth, the pattern will have two lobes on one side of the antenna wire, and one larger lobe on the other side.

ANSWER A: The dipoles gives you a figure 8 pattern at right angles to the antenna wire. Reception is minimal off the ends.

3BI-6.3 How does proximity to the ground affect the radiation pattern of a horizontal dipole HF antenna?

A. If the antenna is too far from the ground, the pattern becomes unpredictable
B. If the antenna is less than one-half wavelength from the ground, reflected radio waves from the ground distort the radiation pattern of the antenna
C. A dipole antenna's radiation pattern is unaffected by its distance to the ground
D. If the antenna is less than one-half wavelength from the ground, radiation off the ends of the wire is reduced

ANSWER B: Never mount an antenna less than one-half wavelength from the earth. If you do, you will have tremendous signal distortion and an unpredictable radiation pattern.

3BI-6.4 What does the term antenna front-to-back ratio mean?

A. The number of directors versus the number of reflectors
B. The relative position of the driven element with respect to the reflectors and directors
C. The power radiated in the major radiation lobe compared to the power radiated in exactly the opposite direction
D. The power radiated in the major radiation lobe compared to the power radiated 90 degrees away from that direction

ANSWER C: The Yagi antenna gives you an excellent front-to-back ratio. This means that the majority of the power is radiated out the front of the antenna, with little signal wasted to the back or to the sides. See question 3BI-6.6.

3BI-6.5 What effect upon the radiation pattern of an HF dipole antenna will a slightly smaller parasitic parallel element located a few feet away in the same horizontal plane have?

A. The radiation pattern will not change appreciably.
B. A major lobe will develop in the horizontal plane, parallel to the two elements.
C. A major lobe will develop in the vertical plane, away from the ground.
D. If the spacing is greater than 0.1 wavelength, a major lobe will develop in the horizontal plane to the side of the driven element toward the parasitic element.

ANSWER D: This is how the inventor of the Yagi figured out how to improve upon the dipole! By adding a director element in front of the dipole, and a reflector element in back of the dipole, Professor Uda figured out a way to concentrate the energy in just one direction.

3BI-6.6 What is the meaning of the term main lobe as used in reference to a directional antenna?

A. The direction of least radiation from an antenna
B. The point of maximum current in a radiating antenna element
C. The direction of maximum radiated field strength from a radiating antenna
D. The maximum voltage standing wave point on a radiating element

ANSWER C: The main lobe is the main radiating direction of the signal. You may use a field-strength meter to determine the main lobe of most directional antennas.

3BI-7.1 Upon what does the characteristic impedance of a parallel-conductor antenna feed line depend?

A. The distance between the centers of the conductors and the radius of the conductors
B. The distance between the centers of the conductors and the length of the line
C. The radius of the conductors and the frequency of the signal
D. The frequency of the signal and the length of the line

ANSWER A: It's important never to squash coax cable in a window or in a car door. To do so changes the distance between the center conductor and the outside braid, and this changes the characteristic impedance of the cable—whether it's coax or parallel conductor feedline.

3BI-7.2 What is the characteristic impedance of various coaxial cables commonly used for antenna feed lines at amateur stations?

A. Around 25 and 30 ohms
B. Around 50 and 75 ohms
C. Around 80 and 100 ohms
D. Around 500 and 750 ohms

ANSWER B: Most Amateur Radio coax cable is rated at 50 to 52 ohms impedance. Most cable television coax is rated around 75 ohms impedance. This is why it's not wise to use cable TV coax for ham radio installations.

3BI-7.3 What effect, if any, does the length of a coaxial cable have upon its characteristic impedance?

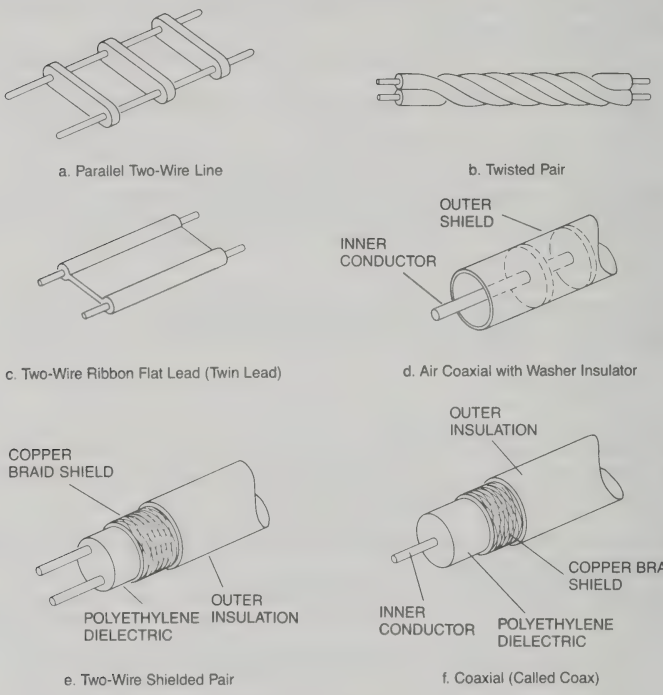
A. The length has no effect on the characteristic impedance
B. The length affects the characteristic impedance primarily above 144 MHz.
C. The length affects the characteristic impedance primarily below 144 MHz.
D. The length affects the characteristic impedance at any frequency.

ANSWER A: Length has no effect on the impedance of cable—but closing it in a door will!

3BI-7.4 What is the characteristic impedance of flat-ribbon TV-type twinlead?

A. 50 ohms
B. 75 ohms
C. 100 ohms
D. 300 ohms

ANSWER D: TV twin-lead might be an effective antenna, but it's usually not used for feedlines because its impedance won't match that of your 50 ohm transmitter.



Different Transmissions Lines

Source: *Antennas — Selection and Installation*, © 1986 Master Publishing, Inc., Richardson, Texas

3BI-8.4 What is the cause of power being reflected back down an antenna feed line?

A. Operating an antenna at its resonant frequency
B. Using more transmitter power than the antenna can handle
C. A difference between feed line impedance and antenna feed-point impedance
D. Feeding the antenna with unbalanced feed line

ANSWER C: Keep your impedances the same for minimum SWR (standing wave ratio). Standing waves are set up on the feed line because power is being reflected back from the impedance mismatch. The SWR is measured with an SWR meter like the one shown in question 3BD-17.2.

3BI-9.3 What will be the standing-wave ratio when a 50-ohm feed line is connected to a resonant antenna having a 200-ohm feed-point impedance?

A. 4:1
B. 1:4
C. 2:1
D. 1:2

ANSWER A: 50 into 200 goes 4 times, so the impedance mismatch is 4:1.

3BI-9.4 What will be the standing-wave ratio when a 50-ohm feed line is connected to a resonant antenna having a 10-ohm feed-point impedance?

A. 2:1
B. 50:1
C. 1:5
D. 5:1

ANSWER D: 10 into 50 goes 5 times, so the impedance mismatch gives you a standing-wave ratio of 5:1.

3BI-9.5 What will be the standing-wave ratio when a 50-ohm feed line is connected to a resonant antenna having a 50-ohm feed-point impedance?

A. 2:1
B. 50:50
C. 1:1
D. 0:0

ANSWER C: This is a perfect match, and you should have minimum SWR providing the antenna has been cut exactly to frequency.

3BI-11.1 How does the characteristic impedance of a coaxial cable affect the amount of attenuation to the RF signal passing through it?

A. The attenuation is affected more by the characteristic impedance at frequencies above 144 MHz than at frequencies below 144 MHz.
B. The attenuation is affected less by the characteristic impedance at frequencies above 144 MHz than at frequencies below 144 MHz.
C. The attenuation related to the characteristic impedance is about the same at all amateur frequencies below 1.5 GHz.
D. The difference in attenuation depends on the emission type in use.

ANSWER C: The loss of signal is usually not affected by the impedance of the coax cable until you exceed 1.5 GHz. The attenuation is most affected by the size of the coax, the length of the coax run, the type of dielectric, and whether or not you have any connectors in line.

3BI-11.2 How does the amount of attenuation to a 2-meter signal passing through a coaxial cable differ from that to a 160-meter signal?

A. The attenuation is greater at 2 meters.
B. The attenuation is less at 2 meters.
C. The attenuation is the same at both frequencies.
D. The difference in attenuation depends on the emission type in use.

ANSWER A: The higher you go in frequency, the greater the attenuation of the transmission line. This is why it's very important to always use the largest size cable available for 2 meters and higher frequencies.

3BI-11.4 What is the effect on its attenuation when flat-ribbon TV-type twin-lead is wet?

A. Attenuation decreases slightly
B. Attenuation remains the same
C. Attenuation decreases sharply
D. Attenuation increases

ANSWER D: Parallel conductor twin lead has greater attenuation when it's wet.

3BI-11.7 Why might silicone grease or automotive car wax be applied to flat-ribbon TV-type twinlead?

A. To reduce "skin effect" losses on the conductors
B. To reduce the buildup of dirt and moisture on the feed line
C. To increase the velocity factor of the feed line
D. To help dissipate heat during high-SWR operation

ANSWER B: If you do use some type of flat-ribbon TV-type twin-lead as your feedline, keep it clean to minimize losses.

3BI-11.8 In what values are RF feed line losses usually expressed?

A. Bels/1000 ft
B. dB/1000 ft
C. Bels/100 ft
D. dB/100 ft

ANSWER D: Coax feed line losses usually are expressed in dB per 100 feet.

Frequency	Attenuation (dB/100 ft.)
2	0.21
10	0.5
20	0.71
100	1.7
200	2.4
1000	5.7

Attenuation of RG-8 Coax with Foam Dielectric

3BI-11.10 As the operating frequency increases, what happens to the dielectric losses in a feed line?

A. The losses decrease
B. The losses decrease to zero
C. The losses remain the same
D. The losses increase

ANSWER D: The higher the frequency, the greater the losses in any piece of coax cable.

3BI-11.12 As the operating frequency decreases, what happens to the dielectric losses in a feed line?

A. The losses decrease
B. The losses increase
C. The losses remain the same
D. The losses become infinite

ANSWER A: The lower the frequency, the lower the losses (usually) and smaller cable may be used.

3BI-12.1 What condition must be satisfied to prevent standing waves of voltage and current on an antenna feed line?

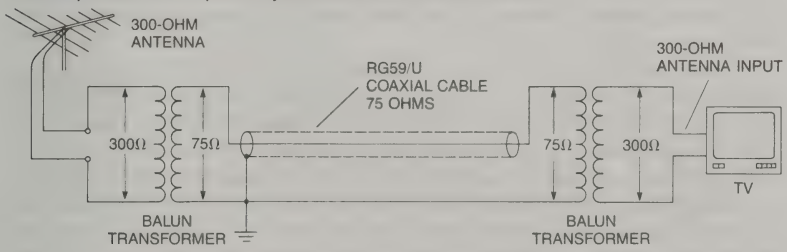
A. The antenna feed point must be at dc ground potential.
B. The feed line must be an odd number of electrical quarter wavelengths long.
C. The feed line must be an even number of physical half wavelengths long.
D. The antenna feed-point impedance must be matched to the characteristic impedance of the feed line.

ANSWER D: All impedances must be matched if you want maximum power transfer from your transmitter to the antenna system.

3BI-12.2 How is an inductively-coupled matching network used in an antenna system consisting of a center-fed resonant dipole and coaxial feed line?

A. An inductively coupled matching network is not normally used in a resonant antenna system.
B. An inductively coupled matching network is used to increase the SWR to an acceptable level.
C. An inductively coupled matching network can be used to match the unbalanced condition at the transmitter output to the balanced condition required by the coaxial line.
D. An inductively coupled matching network can be used at the antenna feed point to tune out the radiation resistance.

ANSWER A: The balun matches your unbalanced coax to a balanced center-fed dipole. The balun goes right up at the dipole feedpoint, and may also serve as a dipole support. It's always a good idea to use a dipole with a balun to minimize SWR and help match the dipole to your feed line and transmitter.



Transformer Matching Using Coaxial Cable from Antenna to TV Set

Source: *Antennas — Selection and Installation.* © 1986 Master Publishing, Inc., Richardson, Texas

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3BI-12.5 What is an antenna-transmission-line mismatch?

A. A condition where the feed-point impedance of the antenna does not equal the output impedance of the transmitter.
B. A condition where the output impedance of the transmitter does not equal the characteristic impedance of the feed line.
C. A condition where a half-wavelength antenna is being fed with a transmission line of some length other than one-quarter wavelength at the operating frequency.
D. A condition where the characteristic impedance of the feed line does not equal the feed-point impedance of the antenna.

ANSWER D: If there is a mismatch, it will reduce the amount of power that ultimately is fed into the antenna system.

4

Taking the General Class Examination

ABOUT THIS CHAPTER

Get ready for worldwide privileges! As soon as you pass your General Class code and theory test, you will be permitted on the bands where you can talk to the world every hour of every day and night. This chapter tells you how the examination will be given, who is qualified to give it, and what happens after you successfully complete the examination.

EXAMINATION ADMINISTRATION

Unlike the Novice Class that can be given anywhere by any two licensed General Class and higher hams at anytime, the General Class examination must be taken at a volunteer examination official test session.

The FCC no longer conducts Amateur Radio services examinations; all examinations are conducted by volunteer amateur operators. The test sessions are coordinated by national or regional volunteer-examiner coordinators (VECs) who accredit Advanced Class and Extra Class ham operators to serve as volunteer examiners (VEs).

Three officially certified VEs are required to administer a General Class examination. The VEs are not compensated for their time and skills, but they are permitted to charge you a test fee for certain reimbursable expenses incurred in preparing, processing, or administering the examination. The maximum fee is adjusted annually by the FCC. It is usually less than $5.50.

The three volunteer examiners form a team called a volunteer examination team (VET), and they offer local amateur class examinations regularly at local sites to serve their community. The VETs coordinate closely and rotate examination sites so you should be able to find a test site near you. You can obtain information about VETs and examination sessions by checking with your local radio club, ham radio store, and local packet bulletin boards. If this is not convenient, write or call the VEC that serves your area. The VEC will be able to give you the name, address and telephone number of your local VET. A list of VECs that was current at the time of publication is given in the Appendix. Many VETs allow "walk-ins," but some don't like surprises.

Once you have found your examination location and set the date, you should write the VET for confirmation so they will hold a seat for you. Make a reservation and keep it. Don't be a "no show." And, if at all possible, don't be a "surprise show." Let them know ahead of time you are coming, and keep your date.

EXAM CONTENT

The FCC previously handled Amateur Radio services testing. They developed the questions, the multiple choices, and identified the correct answers. It was all sort of secret! Neither the questions, nor the correct answers, were really widely known. That has changed. The FCC has been transferring testing responsibility—including development of examination questions—over to the amateur community in phases since 1982, when President Reagan signed legislation providing for volunteer amateur operator examinations above the Novice Class. VECs periodically revise the questions in the various amateur operator class question pools, and recommend multiple-choice answers to the VEs. The VEs are responsible for the answers, but most VEs accept the multiple-choice answers, both correct and incorrect, supplied by the VECs.

FCC Follows FAA

While the questions for the various examinations are developed by VECs, the answers are at present only suggested. It is possible that a VET could supply its own answer formats! Thus, the potential exists for a VET to supply answers and answer formats different from those contained in this book. While we seriously doubt that this will happen, it is important that you be aware that it could. The Amateur Radio services examination system adopted by most VECs and VEs is similar to that used by the FAA for testing pilots. For FAA testing, pilots know all the possible questions that might be on an examination. Since it works for the FAA, the FCC has adopted the same technique. Amateur operators are given that same privilege of knowing all their examination questions before they take an examination.

COMPLETING THE FCC FORM 610

A FCC Form 610, APPLICATION FOR AMATEUR RADIO STATION AND/OR OPERATOR LICENSE, should be completed before you are administered the General Class examination. We've included one in the back of this book for your use. If you have need for others, be sure to use the most recent version. Do not be concerned with the FCC expiration date on the Form 610. The 610 form bound in this book is indeed valid and will be accepted by your local VET. You can obtain additional Form 610s from your area VEC, or by writing the FCC at P.O. Box 1020, Gettysburg, PA 17326. Be sure to enclose a large, self-addressed, stamped envelope with your request. If you need more information, call their Public Assistance Office at (717) 337-1212.

Your Portion

It is *very important* that you complete the application legibly. It will save you a lot of grief anytime you upgrade. Refer to a sample filled-out Form 610 that is in the appendix of this book. Unless you note changes, data on subsequent applications are electronically compared with previous applications. Your application for upgrade is rejected if the data doesn't match your original

Novice and/or Technician license. Double-check that you didn't skip any boxes that are required. Be sure your signature on line 13 matches your name on line 5. Check the sample Form 610 again.

Your Examiner's Portion

The VET that administers your General Class examination must complete the ADMINISTERING VE's REPORT on the front of the form and certify your application in Section II-B. They will mail it to their VEC for FCC processing. You should receive your General Class license in about six weeks. However, you can go on the General airwaves *immediately* with a temporary identifier added to your present Novice or Technician call sign!

TAKING THE EXAMINATION

Get a good night's sleep before exam day. Continue to study right up to the moment you go into the examination room. Don't believe that old saying that too much study will cause you to forget subject material. Gordon West's Radio School offers cassette tapes that cover the theory and code needed for the General examination. You may want to purchase a set and listen to them while you are waiting to take your test. They also have upgrade theory and code cassettes for license classes from Advanced to Extra.

What to Bring to the Site

Here's what you'll need for your General Class examination:

1. Examination fee of approximately $5.50 *in cash*, exact change. No checks!
2. The original, plus two copies, of your current Technician license. *Note:* If your Technician license has not yet arrived from the FCC, some VETs may allow you to take the General examination anyway. Bring *any* upgrade certificate, including your completed Form 610 before it was sent to the FCC for your Novice or Technician license, plus a copy, to the exam session.
3. Some form of personal identification with a photo; a driver's license is ideal.
4. Accurately filled out FCC Form 610 for your upgrade.
5. Some sharp pencils and fine-tip pens. It's good to have a backup.
6. Calculators may be used, but the examiners may erase the memory before you start the test.
7. A letter from your physician indicating your handicap if you are requesting a handicapped exam. If you need any special equipment, you may supply it. See page 10 for information on waiver granted to handicapped by FCC.
8. Any other item that the VET asks you to bring. Donuts are welcome! Remember, these volunteers receive no pay for their work!

Check and Double-Check

Read over the questions carefully. Take your time in looking for the correct answer. Some answers start out looking correct, but end up wrong. Don't speed read the test.

When you're finished, go back over every question and double check your answers. Try that game where you read what you have selected as the correct answer, and see if it agrees with the question.

When you are satisfied that you have passed the examination, turn in all of your test papers to the examination team. When you are told that you passed the test, be sure that you are given the appropriate passing paperwork.

- Is your CERTIFICATE OF COMPLETION signed by all three examiners?
- Did they fill in the temporary identifier that you may use to immediately go on the air at the new General Class frequencies?
- In the excitement, did you leave anything behind? Did you bring someone with you who is still in the examination room?

Let the examination team know how much you appreciate their unselfish efforts to help promote ham radio upgrades. If you are the last one out of the room, volunteer to help them take down the testing location. They will appreciate your offer.

Wait patiently outside for the results. Chances are they will greet you with a smile and your certificate of completion. If you didn't pass, they will tell you what to do next.

GOING FURTHER

You could go ahead and take the Advanced Class 50-question written examination at this session if the VET is willing to administer it. The new rules permit you to take the written theory examination ahead of the code test. If you pass the written Advanced Class examination, you may go on the air immediately using Advanced Class privileges. There is no further code test for the Advanced Class after you have passed the General Class code test.

If you pass the Advanced Class theory examination with flying colors, why not try the Extra Class theory examination. Remember, you may take the Extra Class written theory examination long before you prepare for the 20-wpm Extra Class code test. The Extra Class theory examination contains 40 questions and multiple-choice answers. If you are successful at General theory and Advanced theory, try the Extra theory! You will have one year to bring your code speed up to 20 wpm for Extra Class if you pass the theory examination.

GENERAL CLASS CALL SIGNS

General Class call signs are in a 1x3 format; for example, N6NOA. If you upgraded your Novice call sign to a Technician Class call sign, you continue to use your Technician Class call sign for General Class. Technician and General Class operators share the same 1x3 format.

However, if you presently have a Novice 2x3 format call sign; for example, KB6XYZ, then you may wish to check item number 2E in Section I on your FCC Form 610 and obtain a General Class 1x3 call sign. It's up to you; you can keep your old Novice call sign or trade it in for a new Technician/General Class call sign.

Group C (1-by-3) call signs have now run out in the 4th, 6th *and Puerto Rico* call districts. Technician/General Class amateurs are next assigned Group D (2-by-3 format) call signs when all Group C have been assigned. Upgrading Novices holding a 2-by-3 format call sign in the 4th, 6th and Puerto Rico call areas will no longer be able to request a Group C call sign and will be automatically assigned *another* more recent 2-by-3 format call sign if they do! The FCC will not be going back and reassigning unused K and W 1-by-3 format call signs. *(Source: FCC)*

CONGRATULATIONS, YOU PASSED!

After you pass the examination, congratulations are in order and a big welcome to the worldwide privileges of General Class. Day or night, summer or fall, sunshine or rain, there is always a worldwide band wide open and ready for General Class voice, code, RTTY, and television communications. Your new worldwide privileges are added to your existing VHF and UHF privileges.

Some Amateur Radio services materials dealers, such as Gordon West's Radio School, offer free certificates indicating you passed the General Class examination. They also have equipment rebate coupons from leading radio manufacturers. All you need to do is contact the dealers, and they will send the certificates and coupons to you. See the appendix for the Gordon West's Radio School's address.

Before you go on the air, do a lot of listening. This will assure that you get started on the right foot on your new worldwide privileges. Remember, even the worldwide bands have a band plan, so make sure that you are operating within the band plan for your worldwide communications.

SUMMARY

Now that you have your General Class license, you may set your sights on the Advanced Class license—your next step up the ladder. Advanced Class operators gain no additional bands—only a little bit more elbow room on the voice portion of each worldwide band. The Advanced Class license will also allow you to step into a new call sign using a 2x2 format; for example, AB6NA.

Welcome to the world of Amateur Radio services worldwide operation. You are now part of a select group of approximately 115,000 Americans that hold a worldwide General Class amateur operator/primary station license. There is a world full of communications ahead of you, and the worldwide bands are now available to you to make new friends and establish communications wherever, and whenever! Happy DXing!

Appendix

POPULAR Q SIGNALS

Given below are a number of Q signals whose meanings most often need to be expressed with brevity and clarity in amateur work. (Q abbreviations take the form of questions only when each is sent followed by a question mark.)

QRG Will you tell me my exact frequency (or that of _____)? Your exact frequency (or that of _____) is _____ kHz.
QRH Does my frequency vary? Your frequency varies.
QRI How is the tone of my transmission? The tone of your transmission is _____ (1. Good; 2. Variable; 3. Bad).
QRJ Are you receiving me badly? I cannot receive you. Your signals are too weak.
QRK What is the intelligibility of my signals (or those of _____)? The intelligibility of your signals (or those of _____) is _____ (1. Bad; 2. Poor; 3. Fair; 4. Good; 5. Excellent).
QRL Are you busy? I am busy (or I am busy with _____). Please do not interfere.
QRM Is my transmission being interfered with? Your transmission is being interfered with _____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely).
QRN Are you troubled by static? I am troubled by static _____ (1-5 as under QRM).
QRO Shall I increase power? Increase power.
QRP Shall I decrease power? Decrease power.
QRQ Shall I send faster? Send faster (_____ WPM).
QRS Shall I send more slowly? Send more slowly (_____WPM).
QRT Shall I stop sending? Stop sending.
QRU Have you anything for me? I have nothing for you.
QRV Are you ready? I am ready.
QRW Shall I inform _____ that you are calling on _____ kHz? Please inform _____ that I am calling on _____ kHz.
QRX When will you call me again? I will call you again at _____ hours (on _____ kHz).
QRY What is my turn? Your turn is numbered _____.
QRZ Who is calling me? You are being called by _____ (on _____ kHz).
QSA What is the strength of my signals (or those of _____)? The strength of your signals (or those of _____) is _____ (1. Scarcely perceptible; 2. Weak; 3. Fairly good; 4. Good; 5. Very good).
QSB Are my signals fading? Your signals are fading.
QSD Is my keying defective? Your keying is defective.
QSG Shall I send _____ messages at a time? Send _____ messages at a time.
QSK Can you hear me between your signals and if so can I break in on your transmission? I can hear you between my signals; break in on my transmission.
QSL Can you acknowledge receipt? I am acknowledging receipt.
QSM Shall I repeat the last message which I sent you, or some previous message? Repeat the last message which you sent me [or message(s) number(s) _____].
QSN Did you hear me (or _____) on _____ kHz? I heard you (or _____) on _____ kHz.
QSO Can you communicate with _____ direct or by relay? I can communicate with _____ direct (or by relay through _____).
QSP Will you relay to _____? I will relay to _____.
QST General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."

QSU Shall I send or reply on this frequency (or on _____ kHz)?
QSW Will you send on this frequency (or on _____ kHz)? I am going to send on this frequency (or on _____ kHz).
QSX Will you listen to _____ on _____ kHz? I am listening to _____ on _____ kHz.
QSY Shall I change to transmission on another frequency? Change to transmission on another frequency (or on _____ kHz).
QSZ Shall I send each word or group more than once? Send each word or group twice (or _____ times).
QTA Shall I cancel message number _____? Cancel message number _____.
QTB Do you agree with my counting of words? I do not agree with your counting of words. I will repeat the first letter or digit of each word or group.
QTC How many messages have you to send? I have messages for you (or for _____).
QTH What is your location? My location is _____.
QTR What is the correct time? The time is _____.

Source: ARRL

§ PART 97.3 FCC EMISSION TERMS

(1) CW. International Morse code telegraphy emissions having designators with A, C, H, J or R as the first symbol; 1 as the second symbol; A or B as the third symbol; and emissions J2A and J2B.

(2) Data. Telemetry, telecommand and computer communications emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1 as the second symbol; D as the third symbol; and emission J2D. Only a digital code of a type specifically authorized in this Part may be transmitted.

(3) Image. Facsimile and television emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1, 2 or 3 as the second symbol; C or F as the third symbol; and emissions having B as the first symbol; 7, 8 or 9 as the second symbol; W as the third symbol.

(4) MCW. Tone-modulated international Morse code telegraphy emissions having designators with A, C, D, F, G, H or R as the first symbol; 2 as the second symbol; A or B as the third symbol.

(5) Phone. Speech and other sound emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1, 2 or 3 as the second symbol; E as the third symbol. Also speech emissions having B as the first symbol; 7, 8 or 9 as the second symbol; E as the third symbol. MCW for the purpose of performing the station identification procedure, or for providing telegraphy practice interspersed with speech. Incidental tones for the purpose of selective calling or alerting or to control the level of a demodulated signal may also be considered phone.

(6) Pulse. Emissions having designators with K, L, M, P, Q, V or W as the first symbol; 0, 1, 2, 3, 7, 8, 9 or X as the second symbol; A, B, C, D, E, F, N, W or X as the third symbol.

(7) RTTY. Narrow-band direct-printing telegraphy emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1 as the second symbol; B as the third symbol; and emission J2B. Only a digital code of a type specifically authorized in this Part may be transmitted.

(8) SS. Spread-spectrum emissions using bandwidth-expansion modulation emissions having designators with A, C, D, F, G, H, J or R as the first symbol; X as the second symbol; X as the third symbol. Only a SS emission of a type specifically authorized in this Part may be transmitted.

(9) Test. Emissions containing no information having the designators with N as the third symbol. Test does not include pulse emission with no information or modulation unless pulse emissions are also authorized in the frequency band.

ANTENNA ELEMENT EQUATIONS

Question	Equation
Cubical Quad Antenna	
3BI-3.1, 3BI-3.2	Driven Element (Each Side) $= \frac{1005}{\text{f in MHz}} \div 4$ ft.
3BI-3.3	Reflector Element (Each Side) $= \frac{1030}{\text{f in MHz}} \div 4$ ft.
Delta Loop Antenna (Symmetrical)	
3BI-3.4, 3BI-3.5	Driven Elements (Each Leg) $= \frac{1005}{\text{f in MHz}} \div 3$ ft.
3BI-3.6	Reflector Element (Each Leg) $= \frac{1030}{\text{f in MHz}} \div 3$ ft.
Yagi Antenna	
3BI-3.7	Driven Element $\left(\frac{\lambda}{2}\right) = \frac{472}{\text{f in MHz}}$ ft.
3BI-3.8	Director Element (Shorter Element) $= \frac{458}{\text{f in MHz}}$ ft.
3BI-3.9	Reflector Element (Longer Element) $= \frac{490}{\text{f in MHz}}$ ft.

U.S. VOLUNTEER-EXAMINER COORDINATORS IN THE AMATEUR SERVICE

Anchorage Amateur Radio Club
2628 Turnagain Parkway
Anchorage, AK 99503
(907) 243-2221, 344-5401

ARRL/VEC*
225 Main Street
Newington, CT 06111
(203) 666-1541

Central Alabama VEC, Inc.
606 Tremont Street
Selma, AL 36701
H: (205) 872-1166, 875-7419
O: (205) 874-1688

Charlotte VEC
227 Bennett Lane
Charlotte, NC 28213
(704) 596-2168

DeVry Amateur Radio Society*
3300 North Campbell Avenue
Chicago, IL 60618
(312) 929-8500

Golden Empire Amateur Radio Society
P.O. Box 508
Chico, CA 95927

Greater Los Angeles Amateur Radio Group
9737 Noble Avenue
Sepulveda, CA 91343
(818) 762-5095, 892-2068

Jefferson Amateur Radio Club
P.O. Box 73665
Metairie, LA 70033

Koolau Amateur Radio Club
45-529 Nakuluai Street
Kaneohe, HI 96744
(808) 235-4132

Laurel Amateur Radio Club, Inc.
P.O. Box 3039
Laurel, MD 20708-0039
(301) 953-1065

Mountain Amateur Radio Club
P.O. Box 234
Cumberland, MD 21502
(304) 289-3576

PHD Amateur Radio Association, Inc.
P.O. Box 11
Liberty, MO 64068
(816) 781-7313

Triad Emergency Amateur Radio Club
3504 Stonehurst Place
High Point, NC 27260
(919) 841-7576

Sandarc-VEC
P.O. Box 2456
La Mesa, CA 92044
(619) 465-3926

Sunnyvale VEC Amateur Radio Club
P.O. Box 60142
Sunnyvale, CA 94088-0142
(408) 255-9000

The Milwaukee Radio Amateurs Club, Inc.
1737 N. 116th St.
Wauwatosa, WI 53226
(414) 774-6999

Western Carolina Amateur Radio Society
5833 Clinton Hwy, Suite 203
Knoxville, TN 37912-2545
(615) 688-7771

W5YI-VEC*
P.O. Box 565101
Dallas, TX 75356-5101
(817) 461-6443

*This VEC regularly offers monthly exams in all parts of the country.

Write for graduation certificates to:
Gordon West's Radio School
2414 College Drive
Costa Mesa, CA 92626

Please include:
1. Copy of certificate of completion
2. One double-stamped self-addressed envelope

SAMPLE 13-WPM CODE TESTS

FIRST SEQUENCE:

VVVVVV WA1CVA DE XE1T0 RRR
Tnx Robert, URRST 577--577.
Qth hr is Acapulco, Mexico, and name is Thomas. My rig runs 400 watts into a trap doublet up to 70 feet. My receiver is a swan 350 with 22 tubes. My age is 56 and licensed 21 years a General Class. The weather is hot/dry and the temperature is 92 degrees. My occupation is a sailor. I must QRT soon for some sleep. How copy? WA1CVA DE XEITO AR SK

SECOND SEQUENCE:

VVVVVV W3BL DE KA5GMO RRR
Tnx Mary, UR RST 578--578.
Qth hr is Tulsa, Oklahoma, and name is Martin. My rig runs 225 watts into a rhombic up 30 feet. My receiver is a Yaesu with 17 tubes. My age is 34 and licensed 2 years as Technician Class. The weather is wet/windy and the temperature is 81 degrees. My occupation is physician. I must QRT soon for band practice. How copy? W3BL DE KA5GMO AR SK

THIRD SEQUENCE:

VVVVVV KC2WI DE KP4ER RRR
Tnx Terry. UR RST 589--589
Qth hr is Puerto Rico, and name is Fernando. My rig runs 250 watts into a delta loop up 75 feet. My receiver is a Collins with 24 tubes. My age is 19 and licensed 7 years as Advanced Class. The weather is hot/smoggy and the temperature is 88 degrees. My occupation is a miner. I must QRT soon for jogging. How copy? KC2WI DE KP4ER AR SK

FOURTH SEQUENCE:

VVVVVV KL7HT DE KC7BB RRR
And Tnx Milt, UR RST 555--555.
Qth hr is Ogden, Utah, and name is Ron. My rig runs 350 watts into a quagi up 60 feet. My receiver is Kenwood R4000 with no tubes. My age is 45 and licensed 5 years as Advanced Class. The weather here is wet/foggy and the temperature is 68 degrees. My occupation is singer. I must QRT soon for lunch. How copy? KL7HT DE KC7BB AR SK

FIFTH SEQUENCE:

VVVVV W6TC DE KOGG RRR
And Tnx ALICE, UR RST 599--599.
Qth hr is Fargo, North Dakota, and name is Cindy. My rig runs 120 watts into a doublet Zepp up 50 feet. My receiver is an Icom 72R with 200 transistors. My age is 18 and licensed 1 month as Extra Class. The weather is cool/windy and the temperature is 45 degrees. I must QRT soon for flying lessons. How copy? W6TC DE KOGG AR SK

SIXTH SEQUENCE:

VVVVVV JA7CLA DE N6IGF RRR
And Tnx Peter, UR RST 579--579.
Qth hr is Catalina Island, California, and name is Sue. My rig runs 700 watts into a 5-band vertical up 20 feet. My receiver is a Kenwoood 9130 with 209 transistors. My age is 39 and licensed 10 years as General Class. The weather here is clear/warm and the temperature is 88 degrees. My occupation is nurse. I must QRT soon for an appointment. How copy? JA7CLA DE N6IGF AR SK

FEDERAL COMMUNICATIONS COMMISSION
GETTYSBURG, PA 17326

Approved OMB
3060-0003
Expires 12/31/92
See instructions for information regarding public burden estimate

APPLICATION FOR AMATEUR RADIO STATION AND/OR OPERATOR LICENSE

ADMINISTERING VEs' REPORT	EXAMINATION ELEMENTS							
Applicant is credited for:	1(A)	1(B)	1(C)	2	3(A)	3(B)	4(A)	4(B)
A. CIRCLE CLASS OF FCC AMATEUR LICENSE HELD: N T G A → Class	(NT)	(GA)		(NTGA)	(TGA)	(GA)	(A)	
B. CERTIFICATE(S) OF SUCCESSFUL COMPLETION OF AN EXAMINATION HELD →	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued
C. FCC COMMERCIAL RADIOTELEGRAPH OPERATOR LICENSE HELD → Number / Exp. Date:								
D. EXAMINATION ELEMENTS PASSED THAT WERE ADMINISTERED AT THIS SESSION: →								

E. APPLICANT IS QUALIFIED FOR OPERATOR LICENSE CLASS: ☐ NONE

E1 ☐ NOVICE (Elements 1(A), 1(B), or 1(C) and 2)

E2 ☐ TECHNICIAN (Elements 1(A), 1(B), or 1(C), 2 and 3(A))
☐ GENERAL (Elements 1(B) or 1(C), 2, 3(A), and 3(B))
☐ ADVANCED (Elements 1(B) or 1(C), 2, 3(A), 3(B) and 4(A))
☐ AMATEUR EXTRA (Elements 1(C), 2, 3(A), 3(B), 4(A), and 4(B))

H. Date of VEC coordinated examination session:

I. VEC Receipt Date

F. NAME OF VOLUNTEER EXAMINER COORDINATOR (VEC coordinated sessions only)

G. EXAMINATION SESSION LOCATION: (VEC coordinated sessions only)

SECTION I

1. IF YOU HOLD A VALID LICENSE ATTACH THE ORIGINAL LICENSE OR PHOTOCOPY ON BACK OF APPLICATION. IF THE VALID LICENSE OR CERTIFICATE OF SUCCESSFUL COMPLETION OF AN EXAMINATION WAS LOST OR DESTROYED, PLEASE EXPLAIN

2. CHECK ONE OR MORE ITEMS, NORMALLY ALL LICENSES ARE ISSUED FOR A 10 YEAR TERM.

2A ☐ RENEW LICENSE, NO OTHER CHANGES → EXPIRATION DATE (Month, Day, Year)

2B ☐ REINSTATE LICENSE EXPIRED LESS THAN 2 YEARS

2C ☐ EXAMINATION FOR NEW LICENSE

2D X EXAMINATION TO UPGRADE OPERATOR CLASS — FORMER LAST NAME — SUFFIX (Jr., Sr., etc.)

2E X CHANGE CALL SIGN (Be sure you are eligible – See Inst. 2E)

2F ☐ CHANGE NAME (Give former name) → FORMER FIRST NAME — MIDDLE INITIAL

2G ☐ CHANGE MAILING ADDRESS

2H ☐ CHANGE STATION LOCATION

3. CALL SIGN (If you checked 2C above, skip items 3 and 4): WA6BWH

4. OPERATOR CLASS OF THE ATTACHED LICENSE: TECHNICIAN

5. CURRENT FIRST NAME: MARGARET — M.I.: E. — LAST NAME: FOSTER — SUFFIX (Jr., Sr., etc.): — 6. DATE OF BIRTH (Month, Day, Year): 02/16/42

7. CURRENT MAILING ADDRESS (Number and Street): 12345 MICHI STREET — CITY: CATSVILLE — STATE: CA. — ZIP CODE: 92626

8. CURRENT STATION LOCATION (Do not use a P.O. Box No., RFD No., or General Delivery. See Instruction 8): 12345 MICHI STREET — CITY: CATSVILLE — STATE: CA.

9. Would a Commission grant of your application be an action which may have a significant environmental effect as defined by Section 1.1305 of the Commission's Rules? See instruction 9. If you answer yes, submit the statement as required by Sections 1.1308 and 1.1311. ☐ YES X NO

10. Do you have any other amateur radio application on file with the Commission that has not been acted upon? If yes, answer items 11 and 12. ☐ YES X NO

11. PURPOSE OF OTHER APPLICATION — 12. DATE SUBMITTED (Month, Day, Year)

CERTIFICATION

I CERTIFY THAT all statements herein and attachments herewith are true, complete, and correct to the best of my knowledge and belief, and are made in good faith; that I am not a representative of a foreign government, that I waive any claim to the use of any particular frequency regardless of prior use by license or otherwise; and that the station to be licensed will be inaccessible to unauthorized persons.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM OR ATTACHMENTS ARE PUNISHABLE BY FINE AND IMPRISONMENT U.S. CODE TITLE 18, SECTION 1001

13. SIGNATURE OF APPLICANT (Must match Item 5): Margaret E. Foster — 14. DATE SIGNED: 2-14-91

(OVER)

FCC Form 610, February 1990

(Front Side–Shaded area for applicant)

ATTACH THE ORIGINAL LICENSE OR PHOTOCOPY HERE

SECTION II – EXAMINATION INFORMATION

SECTION II-A FOR NOVICE OPERATOR EXAMINATION ONLY. To be completed by the Administering VEs after completing the Administering VE's Report on the other side of this form.

CERTIFICATION

I CERTIFY THAT I have complied with the Administering VE requirements stated in Part 97 of the Commission's Rules. THAT I have administered to the applicant and graded an amateur radio operator examination in accordance with Part 97 of the Commission's Rules. THAT I have indicated in the Administering VE's Report the examination element(s) the applicant passed. THAT I have examined documents held by the applicant and I have indicated in the Administering VE's Report the examination element for which the applicant is given examination credit in accordance with Part 97 of the Commission's Rules.

1A. VOLUNTEER EXAMINER'S NAME (First, MI, Last, Suffix) *(Print or Type)*

1B. VE'S MAILING ADDRESS (Number, Street, City, State, ZIP Code)

1C. VE'S OPERATOR CLASS ☐ GENERAL ☐ ADVANCED ☐ AMATEUR EXTRA — 1D. VE'S STATION CALL SIGN

1E. LICENSE EXPIRATION DATE — 1F. IF YOU HAVE AN APPLICATION PENDING FOR YOUR LICENSE GIVE FILING DATE

1G. SIGNATURE (Must match Item 1A) — DATE SIGNED

2A. VOLUNTEER EXAMINER'S NAME (First, MI, Last, Suffix) *(Print or Type)*

2B. VE'S MAILING ADDRESS (Number, Street, City, State, ZIP Code)

2C. VE'S OPERATOR CLASS ☐ GENERAL ☐ ADVANCED ☐ AMATEUR EXTRA — 2D. VE'S STATION CALL SIGN

2E. LICENSE EXPIRATION DATE — 2F. IF YOU HAVE AN APPLICATION PENDING FOR YOUR LICENSE GIVE FILING DATE

2G. SIGNATURE (Must match Item 2A) — DATE SIGNED

SECTION II-B FOR TECHNICIAN, GENERAL, ADVANCED, OR AMATEUR EXTRA OPERATOR EXAMINATION ONLY. To be completed by the Administering VEs after completing the Administering VE's Report on the other side of this form.

CERTIFICATION

I CERTIFY THAT I have complied with the Administering VE requirements stated in Part 97 of the Commission's Rules. THAT I have administered to the applicant and graded an amateur radio operator examination in accordance with Part 97 of the Commission's Rules. THAT I have indicated in the Administering VE's Report the examination element(s) the applicant passed. THAT I have examined documents held by the applicant and I have indicated in the Administering VE's Report the examination element(s) for which the applicant is given examination credit in accordance with Part 97 of the Commission's Rules.

1A. VOLUNTEER EXAMINER'S NAME (First, MI, Last, Suffix) *(Print or Type)* — 1B. VE'S STATION CALL SIGN

1C. SIGNATURE (Must match Item 1A) — DATE SIGNED

2A. VOLUNTEER EXAMINER'S NAME (First, MI, Last, Suffix) *(Print or Type)* — 2B. VE'S STATION CALL SIGN

2C. SIGNATURE (Must match Item 2A) — DATE SIGNED

3A. VOLUNTEER EXAMINER'S NAME (First, MI, Last, Suffix) *(Print or Type)* — 3B. VE'S STATION CALL SIGN

3C. SIGNATURE (Must match Item 3A) — DATE SIGNED

FCC Form 610
February 1990

(Back Side–Shaded area for VEs)

AUTHORIZED FREQUENCY BANDS – AMATEUR SERVICE

(for U.S. Amateur Stations operating from ITU-Region 2–North and South America)

Meters	Novice	Technician[1,2]	Technician Plus[2]	General	Advanced	Extra Class
160				1800-2000 kHz/All	1800-2000 kHz/All	1800-2000 kHz/All
80	3675-3725 kHz/CW		3675-3725 kHz/CW	3525-3750 kHz/CW 3850-4000 kHz/Ph	3525-3750 kHz/CW 3775-4000 kHz/Ph	3500-4000 kHz/CW 3750-4000 kHz/Ph
40	7100-7150 KHz/CW		7100-7150 kHz/CW	7025-7150 kHz/CW 7225-7300 kHz/Ph	7025-7300 kHz/CW 7150-7300 kHz/Ph	7000-7300 kHz/CW 7150-7300 kHz/Ph
30				10.1-10-15 MHz/CW	10.1-10.15 MHz/CW	10.1-10-15 MHz/CW
20				14.025-14.15 MHz/CW 14.225-14.35 MHz/Ph	14.025-14.15 MHz/CW 14.175-14.35 MHz/Ph	14.0-14.35 MHz/CW 14.15-14.35 MHz/Ph
15	21.1-21.2 MHz/CW		21.1-21.2 MHz/CW	21.025-21.2 MHz/CW 21.3-21.45 MHz/Ph	21.025-21.2 MHz/CW 21.225-21.45 MHz/Ph	21.0-21.45 MHz/CW 21.2-21.45 MHz/Ph
12				24.89-24.99 MHz/CW 24.93-24.99 MHz/Ph	24.89-24.99 MHz/CW 24.93-24.99 MHz/Ph	24.89-24.99 MHz/CW 24.93-24.99 MHz/Ph
10	28.1-28.5 MHz/CW 28.3-28.5 MHz/Ph		28.1-28.5 MHz/CW 28.3-28.5 MHz/Ph	28.0-29.7 MHz/CW 28.3-29.7 MHz/Ph	28.0-29.7 MHz/CW 28.3-29.7 MHz/Ph	28.0-29.7 MHz/CW 28.3-29.7 MHz/Ph
6		50-54 MHz/CW 50.1-54 MHz/Ph	50-54 MHz/CW 50.1-54 MHz/Ph	50-54 MHz/CW 50.1-54 MHz/Ph	50-54 MHz/CW 50.1-54 MHz/Ph	50-54 MHz/CW 50.1-54 MHz/Ph
2		144-148 MHz/CW 144.1-148 MHz/All	144-148 MHz/CW 144.1-148 MHz/All	144-148 MHz/CW 144.1-148 MHz/Ph	144-148 MHz/CW 144.1-148 MHz/All	144-148 MHz/CW 144.1-148 MHz/All
*1.25	222.1-223.91 MHz/All	222-225 MHz/All	222-225 MHz/All	222-225 MHz/All	222-225 MHz/All	222-225 MHz/All
0.70		420-450 MHz/All	420-450 MHz/All	420-450 MHz/All	420-450 MHz/All	420-450 MHz/All
0.35		902-928 MHz/All	902-928 MHz/All	902-928 MHz/All	902-928 MHz/All	902-928 MHz/All
0.23	1270-1295 MHz/All	1240-1300 MHz/All	1240-1300 MHz/All	1240-1300 MHz/All	1240-1300 MHz/All	1240-1300 MHz/All

[1] No-Code License [2] Effective 2/14/91

Note: Morse code (CW, A1A) may be used on any frequency allocated to the amateur service. Telephony emission (abbreviated Ph above) authorized on certain bands as indicated. Higher class licensees may use slow-scan television and facsimile emissions on the Phone bands; radio teletype/digital on the CW bands. All amateur modes and emissions are authorized above 144.1 MHz. In actual practice, the modes/emissions used are somewhat more complicated than shown above due to the existence of various band plans and "gentlemen's agreements" concerning where certain operations should take place.

*FCC has ruled exclusive allocation for Amateur Radio of 222-225 MHz effective1/1/90. The 220-222 MHz has been allocated to Land Mobile. Operation on these frequencies by amateurs will cease.

Glossary

Amateur communication: Non-commercial radio communication by or among amateur stations solely with a personal aim and without personal or business interest.

Amateur operator/primary station license: An instrument of authorization issued by the Federal Communications Commission comprised of a station license, and also incorporating an operator license indicating the class of privileges.

Amateur operator: A person holding a valid license to operate an amateur station issued by the Federal Communications Commission. Amateur operators are frequently referred to as ham operators.

Amateur Radio services: The amateur service, the amateur-satellite service and the radio amateur civil emergency service.

Amateur-satellite service: A radiocommunication service using stations on Earth satellites for the same purpose as those of the amateur service.

Amateur service: A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs; that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

Amateur station: A station licensed in the amateur service embracing necessary apparatus at a particular location used for amateur communication.

AMSAT: Radio Amateur Satellite Corporation, a nonprofit scientific organization. (P.O. Box #27, Washington, DC 20044)

ARES: The emergency division of the American Radio Relay League. See RACES

ARRL: American Radio Relay League, national organization of U.S. Amateur Radio operators. (225 Main Street, Newington, CT 06111)

Audio Frequency (AF): The range of frequencies that can be heard by the human ear, generally 20 hertz to 20 kilohertz.

Automatic control: The use of devices and procedures for station control without the control operator being present at the control point when the station is transmitting.

Automatic Volume Control (AVC): A circuit that continually maintains a constant audio output volume in spite of deviations in input signal strength.

Beam or Yagi antenna: An antenna array that receives or transmits RF energy in a particular direction. Usually rotatable.

Block diagram: A simplified outline of an electronic system where circuits or components are shown as boxes.

Broadcasting: Information or programming transmitted by radio means intended for the general public.

Business communications: Any transmission or communication the purpose of which is to facilitate the regular business or commercial affairs of any party. Business communications are prohibited in the amateur service.

Call Book: A published list of all licensed amateur operators available in North American and Foreign editions.

Call sign assignment: The FCC systematically assigns each amateur station their primary call sign. The FCC will not grant a request for a specific call sign.

Certificate of Successful Completion of Examination (CSCE): A certificate of successful completion allowing examination credit for 365 days. Both written and code credit can be authorized.

Coaxial cable, Coax: A concentric two-conductor cable in which one conductor surrounds the other, separated by an insulator.

Control operator: An amateur operator designated by the licensee of an amateur station to be responsible for the station transmissions.

Coordinated repeater station: An amateur repeater station for which the transmitting and receiving frequencies have been implemented by a licensee above the Novice class.

Coordinated Universal Time (UTC): Sometimes referred to as Greenwich Mean Time, UCT or Zulu time. The time at the zero-degree (0°) Meridian which passes through Greenwich, England. A universal time among all amateur operators.

Crystal: A quartz or similar material which has been ground to produce natural vibrations of a specific frequency. Quartz crystals produce a high degree of frequency stability in radio transmitters.

CW: Continuous wave, another term for the International Morse code.

Dipole antenna: The most common wire antenna. Length is equal to one-half of the wavelength. Fed by coaxial cable.

Dummy antenna: A device or resistor which serves as a transmitter's antenna without radiating radio waves. Generally used to tune up a radio transmitter.

Duplexer: A device that allows a single antenna to be used for both reception and transmission.

Effective Radiated Power (ERP): The product of the transmitter (peak envelope) power, expressed in watts, delivered to the antenna, and the relative gain of an antenna over that of a half wave dipole antenna.

Emergency communication: Any amateur communication directly relating to the immediate safety of life of individuals or the immediate protection of property.

Examination Credit Certificate: (See Certificate of Successful Completion of Examination)

Examination Element: Novices are required to pass Element 1(A): Beginner's Morse code test at five (5) words-per-minute and Element 2: Basic law comprising rules and regulations essential to beginning operation, including sufficient elementary radio theory for the understanding of the rules.

FCC Form 610: The amateur service application form for an amateur operator/primary station license. It is used to apply for a new amateur license or to renew or modify an existing license.

Federal Communications Commission (FCC): A board of five Commissioners, appointed by the President, having the power to regulate wire and radio telecommunications in the United States.

Feedline Transmission line: A system of conductors that connects an antenna to a receiver or transmitter.

Field Day: Annual activity sponsored by the ARRL to demonstrate emergency preparedness of amateur operators.

Filter: A device used to block or reduce alternating currents or signals at certain frequencies while allowing others to pass unimpeded.

Frequency: The number of cycles of alternating current in one second.

Frequency coordinator: An individual or organization recognized by amateur operators eligible to engage in repeater operation which recommends frequencies and other operating and/or technical parameters for amateur repeater operation in order to avoid or minimize potential interferences.

Frequency Modulation (FM): A method of varying a radio carrier wave by causing its frequency to vary in accordance with the information to be conveyed.

Frequency privileges: The transmitting frequency bands available to the various classes of amateur operators. The Novice privileges are listed in Part 97.7(a) of the FCC rules.

Ground: A connection, accidental or intentional, between a device or circuit and the earth or some common body and the earth or some common body serving as the earth.

Ground wave: A radio wave that is propagated near or at the earth's surface.

Handi-Ham system: Amateur organization dedicated to assisting handicapped amateur operators. (3915 Golden Valley Road, Golden Valley, MN 55422)

Harmful interference: Interference which seriously degrades, obstructs or repeatedly interrupts the operation of a radio communication service.

Harmonic: A radio wave that is a multiple of the fundamental frequency. The second harmonic is twice the fundamental frequency, the third harmonic, three times, etc.

Hertz: One complete alternating cycle per second. Named after Heinrich R. Hertz, a German physicist. The number of hertz is the frequency of the audio or radio wave.

High Frequency (HF): The band of frequencies that lie between 3 and 30 Megahertz. It is from these frequencies that radio waves are returned to earth from the ionosphere.

High-Pass filter: A device that allows passage of high frequency signals but attenuates the lower frequencies. When installed on a television set, a high-pass filter allows TV frequencies to pass while blocking lower frequency amateur signals.

Ionosphere: Outer limits of atmosphere from which HF amateur communications signals are returned to earth.

Jamming: The intentional malicious interference with another radio signal.

Key clicks, Chirps: Defective keying of a telegraphy signal sounding like tapping or high varying pitches.

Lid: Amateur slang term for poor radio operator.

Linear amplifier: A device that accurately reproduces a radio wave in magnified form.

Long wire: A horizontal wire antenna that is one wavelength or longer in length.

Low-Pass filter: Device connected to worldwide transmitters that inhibits passage of higher frequencies that cause television interference but does not affect amateur transmissions.

Machine: A ham slang word for an automatic repeater station.

Malicious interference: Willful, intentional jamming of radio transmissions.

MARS: The Military Affiliate Radio System. An organization that coordinates the activities of amateur communications with military radio communications.

Maximum authorized transmitting power: Amateur stations must use no more than the maximum transmitter power necessary to carry out the desired communications. The maximum P.E.P. output power levels authorized Novices are 200 watts in the 80-, 40-, 15- and 10-meter bands, 25 watts in the 220-MHz band, and 5 watts in the 1270-MHz bands.

Maximum usable frequency: The highest frequency that will be returned to earth from the ionosphere.

Medium frequency (MF): The band of frequencies that lies between 300 and 3,000 kHz (3 MHz).

Mobile operation: Radio communications conducted while in motion or during halts at unspecified locations.

Mode: Type of transmission such as voice, teletype, code, television, facsimile.

Modulate: To vary the amplitude, frequency or phase of a radio frequency wave in accordance with the information to be conveyed.

Morse code (see CW): The International Morse code, A1A emission. Interrupted continuous wave communications conducted using a dot-dash code for letters, numbers and operating procedure signs.

Novice operator: An FCC licensed entry-level amateur operator in the amateur service. Novices may operate a transmitter in the following meter wavelength bands: 80, 40, 15, 10, 1.25 and 0.23.

Ohm's law: The basic electrical law explaining the relationship between voltage, current and resistance. The current I in a circuit is equal to the voltage E divided by the resistance R, or $I = E/R$.

OSCAR: Stands for "Orbiting Satellite Carrying Amateur Radio," the name given to a series of satellites designed and built by amateur operators of several nations.

Oscillator: A device for generating oscillations or vibrations of an audio or radio frequency signal.

Packet radio: A digital method of communicating computer-to-computer. A terminal-node controller makes up the packet of data and directs it to another packet station.

Peak Envelope Power (PEP): 1. The power during one radio frequency cycle at the crest of the modulation envelope, taken under normal operating conditions. 2. The maximum power that can be obtained from a transmitter.

Phone patch: Interconnection of amateur service to the public switched telephone network.

Power supply: A device or circuit that provides the appropriate voltage and current to another device or circuit.

Propagation: The travel of electromagnetic waves or sound waves through a medium.

Q-signals: International three-letter abbreviations beginning with the letter Q used primarily to convey information using the Morse code.

QSL Bureau: An office that bulk processes QSL (radio confirmation) cards for (or from) foreign amateur operators as a postage saving mechanism.

RACES (radio amateur civil emergency service): A radio service using amateur stations for civil defense communications during periods of local, regional, or national civil emergencies.

Radiation: Electromagnetic energy, such as radio waves, traveling forth into space from a transmitter.

Radio Frequency (RF): The range of frequencies over 20 kilohertz that can be propagated through space.

Radio wave: A combination of electric and magnetic fields varying at a radio frequency and traveling through space at the speed of light.

Repeater operation: Automatic amateur stations that retransmit the signals of other amateur stations. Novices may operate through amateur repeaters in the 222-MHz and 1270-MHz bands.

RST Report: A telegraphy signal report system of Readability, Strength and Tone.

S-meter: A voltmeter calibrated from 0 to 9 that indicates the relative signal strength of an incoming signal at a radio receiver.

Selectivity: The ability of a circuit (or radio receiver) to separate the desired signal from those not wanted.

Sensitivity: The ability of a circuit (or radio receiver) to detect a specified input signal.

Short circuit: An unintended low resistance connection across a voltage source resulting in high current and possible damage.

Shortwave: The high frequencies that lie between 3 and 30 Megahertz that are propagated long distances.

Single-Sideband (SSB): A method of radio transmission in which the RF carrier and one of the sidebands is suppressed and all of the information is carried in the one remaining sideband.

Skip wave, Skip zone: A radio wave reflected back to earth. The distance between the radio transmitter and the site of a radio wave's return to earth.

Sky wave: A radio wave that is refracted back to earth in much the same way that a stone thrown across water skips out. Sometimes called an ionospheric wave.

Spectrum: A series of radiated energies arranged in order of wavelength. The radio spectrum extends from 20 kilohertz upward.

Spurious Emissions: Unwanted radio frequency signals emitted from a transmitter that sometimes causes interference.

Station license, location: No transmitting station shall be operated in the amateur service without being licensed by the Federal Communications Commission. Each amateur station shall have one land location, the address of which appears in the station license.

Sunspot Cycle: An 11-year cycle of solar disturbances which greatly affects radio wave propagation.

Technician: A no-code amateur operator who has all privileges from 6 meters on up to shorter wavelengths, but *no* privileges on 10, 15, 40, or 80 meter wavelength bands.

Technician Plus: An amateur operator who has passed a 5-wpm code test in addition to Technician Class requirements.

Telegraphy: Telegraphy is communications transmission and reception using CW International Morse Code.

Telephony: Telephony is communications transmission and reception in the voice mode.

Telecommunications: The electrical conversion, switching, transmission and control of audio signals by wire or radio. Also includes video and data communications.

Temporary operating authority: Authority to operate your amateur station while awaiting arrival of an upgraded license. New Novice operators are not granted temporary operating authority and must await receipt of their new license and call sign.

Terrestrial station location: Any location within the major portion of the earth's atmosphere, including air, sea and land locations.

Third-party traffic: Amateur communication by or under the supervision of the control operator at an amateur station to another amateur station on behalf of others.

Transceiver: A combination radio transmitter and receiver.

Transmatch: An antenna tuner used to match the impedance of the transmitter output to the transmission line of an antenna.

Transmitter: Equipment used to generate radio waves. Most commonly, this radio carrier signal is amplitude varied or frequency varied (modulated) with information and radiated into space.

Transmitter power: The average peak envelope power (output) present at the antenna terminals of the transmitter. The term "transmitted" includes any external radio frequency power amplifier which may be used.

Ultra High Frequency (UHF): Ultra high frequency radio waves that are in the range of 300 to 3,000 MHz.

Upper Sideband (USB): The proper operating mode for sideband transmissions made in the new Novice 10-meter voice band. Amateurs generally operate USB at 20 meters and higher frequencies; lower sideband (LSB) at 40 meters and lower frequencies.

Very High Frequency (VHF): Very high frequency radio waves that are in the range of 30 to 300 MHz.

Volunteer Examiner: An amateur operator of at least a General Class level who administers or prepares amateur operator license examinations. A VE must be at least 18 years old and not related to the applicant.

Volunteer Examiner Coordinator (VEC): A member of an organization which has entered into an agreement with the FCC to coordinate the efforts of volunteer examiners in preparing and administering examinations for amateur operator licenses.

Index

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- Governed by a board of directors elected every two years by the League membership.
- Fighting for amateurs' rights, the League has "come through" for its members in many instances, i.e. Novice Enhancement adopted by the FCC in January 1987.
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- A variety of books about every aspect of Amateur Radio are published annually.
- Written by hams for hams, *QST*, the monthly membership journal, is furnished to all members.

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Join the ARRL today.

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THE AMERICAN RADIO RELAY LEAGUE, INC

225 MAIN STREET **NEWINGTON, CONNECTICUT, USA 06111**

A bona fide interest in Amateur Radio is the only essential requirement, but full voting membership is granted only to licensed radio amateurs of the US. Therefore if you have a license, please be sure to indicate it below. Please print.

( ) New Member ( ) Previous Member ( ) Renewal

Class of License Call Sign Date of Application

Name

Address

City, State, ZIP

Membership Class	☐ Regular		☐ Family ☐ Blind	☐ 65 or older	
	US	ELSEWHERE*		US	ELSEWHERE*
☐ 1 year	$30	$42	$4	$24	$36
☐ 2 years	57	81	8	45	69
☐ 3 years	80	116	12	65	101

IMPORTANT: Please attach your Expiration Notice to this form if you are renewing your current membership. Payment in US Funds only.

*These rates include the postage surcharge which partially offsets the additional cost to mail *QST* outside the US.

A member of the immediate family of a League member, living at the same address, may become a League member without *QST* at the special rate of $4 per year. Family membership must run concurrently with that of the member receiving *QST*. Blind amateurs may join without *QST* for $4 per year.

Persons who are age 65 or older may upon request apply for League membership at the reduced rates shown. A one-time proof of age, in the form of a driver's license or birth certificate is required. If you are 17 or younger, a special rate may apply. Please see reverse side for further information.

Your membership certificate will be mailed to you in about 2 weeks from the date we receive your application. Delivery of *QST* may take slightly longer, but future issues should reach you on a regular basis. Membership is available only to individuals. Fifty percent of dues is allocated to *QST*, and the balance for membership.

DUES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

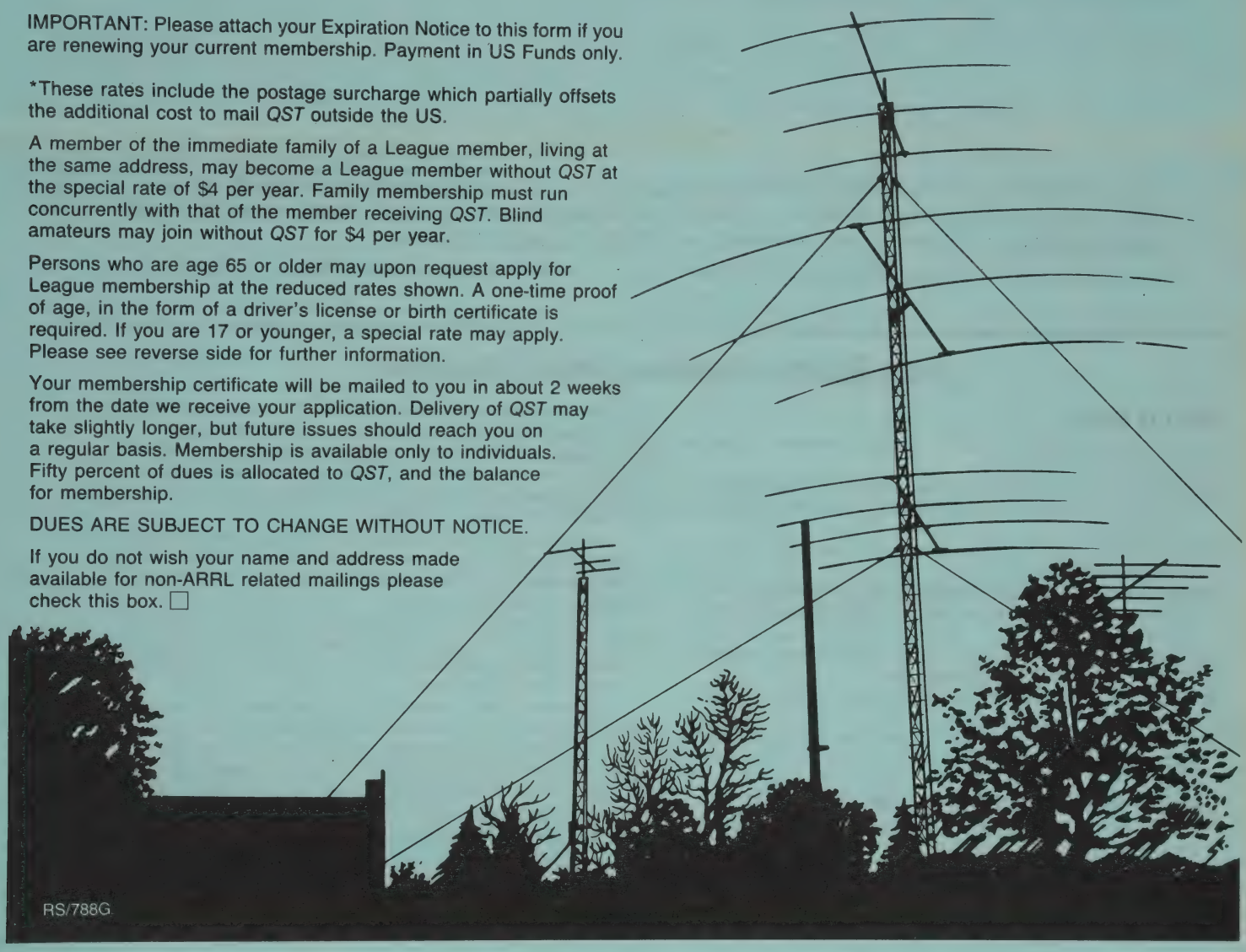
If you do not wish your name and address made available for non-ARRL related mailings please check this box. ☐

Join ARRL!

The Largest Organization of Radio Amateurs in the US

- Receive Monthly QST Journal
- Use QSL Bureau – Clearing House for Overseas QSL Cards
- Low-Cost Equipment Replacement Insurance Available for Home and Car
- Representation in Washington for All Matters Concerning Amateur Radio
- League-Member-Only Awards

(More information on the back side)



RS/788G

Are you 17 or younger?
Are you the oldest, licensed Amateur in your household?

If you can answer "YES" to both, these reduced rates apply to you!

Evidence of date of birth is required. Attach a copy of your birth certificate or driver's license, or have your parent or guardian complete the next line:

Applicant's Date of Birth _____ Signature _____ ☐ Parent ☐ Guardian

Please check the annual membership rate which applies to you:

☐ I am 13 to 17 years of age and the oldest, licensed Amateur in my household.
☐ $15.00 US & Possessions

☐ I am 12 or under and the oldest, licensed Amateur in my household.
☐ $7.50 US & Possessions

Name _____ Call _____

Street _____

City _____ State _____ ZIP _____

Other licensed Amateurs in my household are:

Name _____ Call _____ Age _____

_____ _____ _____

_____ _____ _____

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FEDERAL COMMUNICATIONS COMMISSION
GETTYSBURG, PA 17326

Approved OMB
3060-0003
Expires 12/31/92
See instructions for information regarding public burden estimate

APPLICATION FOR AMATEUR RADIO STATION AND/OR OPERATOR LICENSE

ADMINISTERING VEs' REPORT		EXAMINATION ELEMENTS							
Applicant is credited for: ➔		1(A)	1(B)	1(C)	2	3(A)	3(B)	4(A)	4(B)
A. CIRCLE CLASS OF FCC AMATEUR LICENSE HELD: N T G A	**Class** ➔	(NT)	(GA)		(NTGA)	(TGA)	(GA)	(A)	
B. CERTIFICATE(S) OF SUCCESSFUL COMPLETION OF AN EXAMINATION HELD: ➔		Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued	Date Issued
C. FCC COMMERCIAL RADIOTELEGRAPH OPERATOR LICENSE HELD:	Number: / Exp. Date:								
D. EXAMINATION ELEMENTS PASSED THAT WERE ADMINISTERED AT THIS SESSION: ➔									

E. APPLICANT IS QUALIFIED FOR OPERATOR LICENSE CLASS: ☐ NONE:

E1. ☐ NOVICE (Elements 1(A), 1(B), or 1(C) and 2)

E2.
- ☐ TECHNICIAN (Elements 1(A), 1(B), or 1(C), 2 and 3(A))
- ☐ GENERAL (Elements 1(B) or 1(C), 2, 3(A), and 3(B))
- ☐ ADVANCED (Elements 1(B) or 1(C), 2, 3(A), 3(B) and 4(A))
- ☐ AMATEUR EXTRA (Elements 1(C), 2, 3(A), 3(B), 4(A), and 4(B))

F. NAME OF VOLUNTEER-EXAMINER COORDINATOR: (VEC coordinated sessions only)

G. EXAMINATION SESSION LOCATION: (VEC coordinated sessions only)

H. Date of VEC coordinated examination session:

I. VEC Receipt Date:

SECTION I

1. **IF YOU HOLD A VALID LICENSE ATTACH THE ORIGINAL LICENSE OR PHOTOCOPY ON BACK OF APPLICATION. IF THE VALID LICENSE OR CERTIFICATE OF SUCCESSFUL COMPLETION OF AN EXAMINATION WAS LOST OR DESTROYED, PLEASE EXPLAIN.**

2. **CHECK ONE OR MORE ITEMS, NORMALLY ALL LICENSES ARE ISSUED FOR A 10 YEAR TERM.**

- **2A.** ☐ RENEW LICENSE—NO OTHER CHANGES ➔
- **2B.** ☐ REINSTATE LICENSE EXPIRED LESS THAN 2 YEARS ➔
- **2C.** ☐ EXAMINATION FOR NEW LICENSE
- **2D.** ☐ EXAMINATION TO UPGRADE OPERATOR CLASS
- **2E.** ☐ CHANGE CALL SIGN (Be sure you are eligible—See Inst. 2E)
- **2F.** ☐ CHANGE NAME (Give former name) ➔
- **2G.** ☐ CHANGE MAILING ADDRESS
- **2H.** ☐ CHANGE STATION LOCATION

EXPIRATION DATE (Month, Day, Year)

FORMER LAST NAME SUFFIX (Jr., Sr., etc.)

FORMER FIRST NAME MIDDLE INITIAL

3. CALL SIGN (If you checked 2C above, skip items 3 and 4)

4. OPERATOR CLASS OF THE ATTACHED LICENSE:

5. CURRENT FIRST NAME | M.I. | LAST NAME | SUFFIX (Jr., Sr., etc.)

6. DATE OF BIRTH __ __/__ __/__ __ (MONTH DAY YEAR)

7. CURRENT MAILING ADDRESS (Number and Street) | CITY | STATE | ZIP CODE

8. CURRENT STATION LOCATION (Do not use a P.O. Box No., RFD No., or General Delivery. See Instruction 8) | CITY | STATE

9. Would a Commission grant of your application be an action which may have a significant environmental effect as defined by Section 1.1307 of the Commission's Rules? See instruction 9. If you answer yes, submit the statement as required by Sections 1.1308 and 1.1311. ☐ YES ☐ NO

10. Do you have any other amateur radio application on file with the Commission that has not been acted upon? If yes, answer items 11 and 12. ☐ YES ☐ NO

11. PURPOSE OF OTHER APPLICATION

12. DATE SUBMITTED (Month, Day, Year)

CERTIFICATION

I CERTIFY THAT all statements herein and attachments herewith are true, complete, and correct to the best of my knowledge and belief and are made in good faith; that I am not a representative of a foreign government; that I waive any claim to the use of any particular frequency regardless of prior use by license or otherwise; and that the station to be licensed will be inaccessible to unauthorized persons.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM OR ATTACHMENTS ARE PUNISHABLE BY FINE AND IMPRISONMENT U.S. CODE TITLE 18, SECTION 1001

13. SIGNATURE OF APPLICANT: (Must match Item 5)

14. DATE SIGNED:

(OVER)

ATTACH THE ORIGINAL LICENSE OR PHOTOCOPY HERE

SECTION II – EXAMINATION INFORMATION

SECTION II-A FOR NOVICE OPERATOR EXAMINATION ONLY. To be completed by the Administering VEs after completing the Administering VE's Report on the other side of this form.

CERTIFICATION

I CERTIFY THAT I have complied with the Administering VE requirements stated in Part 97 of the Commission's Rules; THAT I have administered to the applicant and graded an amateur radio operator examination in accordance with Part 97 of the Commission's Rules; THAT I have indicated in the Administering VE's Report the examination element(s) the applicant passed; THAT I have examined documents held by the applicant and I have indicated in the Administering VE's Report the examination element for which the applicant is given examination credit in accordance with Part 97 of the Commission's Rules.

1A. VOLUNTEER EXAMINER'S NAME: (First, MI, Last, Suffix) *(Print or Type)*

1B. VE'S MAILING ADDRESS: (Number, Street, City, State, ZIP Code)

1C. VE'S OPERATOR CLASS:
☐ GENERAL ☐ ADVANCED ☐ AMATEUR EXTRA

1D. VE'S STATION CALL SIGN

1E. LICENSE EXPIRATION DATE:

1F. IF YOU HAVE AN APPLICATION PENDING FOR YOUR LICENSE, GIVE FILING DATE:

1G. SIGNATURE: (Must match Item 1A)

DATE SIGNED

2A. VOLUNTEER EXAMINER'S NAME: (First, MI, Last, Suffix) *(Print or Type)*

2B. VE'S MAILING ADDRESS: (Number, Street, City, State, ZIP Code)

2C. VE'S OPERATOR CLASS:
☐ GENERAL ☐ ADVANCED ☐ AMATEUR EXTRA

2D. VE'S STATION CALL SIGN

2E. LICENSE EXPIRATION DATE:

2F. IF YOU HAVE AN APPLICATION PENDING FOR YOUR LICENSE, GIVE FILING DATE:

2G. SIGNATURE: (Must match Item 2A)

DATE SIGNED

SECTION II-B FOR TECHNICIAN, GENERAL, ADVANCED, OR AMATEUR EXTRA OPERATOR EXAMINATION ONLY. To be completed by the Administering VEs after completing the Administering VE's Report on the other side of this form.

CERTIFICATION

I CERTIFY THAT I have complied with the Administering VE requirements stated in Part 97 of the Commission's Rules; THAT I have administered to the applicant and graded an amateur radio operator examination in accordance with Part 97 of the Commission's Rules; THAT I have indicated in the Administering VE's Report the examination element(s) the applicant passed; THAT I have examined documents held by the applicant and I have indicated in the Administering VE's Report the examination element(s) for which the applicant is given examination credit in accordance with Part 97 of the Commission's Rules.

1A. VOLUNTEER EXAMINER'S NAME: (First, MI, Last, Suffix) *(Print or Type)*

1B. VE'S STATION CALL SIGN:

1C. SIGNATURE: (Must match Item 1A)

DATE SIGNED:

2A. VOLUNTEER EXAMINER'S NAME: (First, MI, Last, Suffix) *(Print or Type)*

2B. VE'S STATION CALL SIGN:

2C. SIGNATURE: (Must match Item 2A)

DATE SIGNED:

3A. VOLUNTEER EXAMINER'S NAME: (First, MI, Last, Suffix) *(Print or Type)*

3B. VE'S STATION CALL SIGN:

3C. SIGNATURE: (Must match Item 3A)

DATE SIGNED:

NEW

General Class

Your worldwide voice license – General Class. Take that step in a quick and easy way. Upgrade your code skills with speed building audio tapes that take you from 5 to 13 words per minute in a relaxed *fun* way. Your study for the written examination is made easy with study hints, the complete question pool, the correct answers – with an explanation why the answer is correct. Even a Form 610 application is included!

New General Class provides everything you need to make it easy to learn about, prepare for, and pass your General Class examination and obtain your FCC General Class Amateur Radio license.

For the Code Portion – FCC Element 1B

Two long-play cassettes help you have fun building your CW Morse code speed to the 13 words per minute required for the General code test. Several sample code tests included, just like the real VEC tests!

For the Written (or Theory) Portion – FCC Element 3B

A study guide containing the exact 286 questions used for the General Class question pool makes studying easy. There will be 25 questions on your exam.

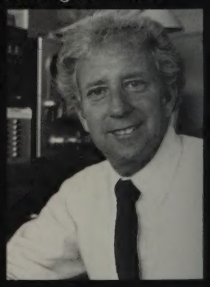
Correct answers are chosen from multiple choices available and an explanation given as to why the answer is correct. Includes charts, diagrams and formulas for an easy-to-understand approach to learning.

ABOUT THE AUTHOR

Gordon West has been a ham for over 25 years, holding an Extra Class license, call sign WB6NOA. Gordon holds the highest Federal Communications Commission commercial radio telephone operator license, the First Class General Radiotelephone Certificate with radar endorsement. He is a fellow of the Radio Club of America as well as a life member of the American Radio Relay League.

Gordon is a well known author in the communications field. He writes monthly electronics columns in over 12 national publications and several communications industry newsletters. Gordon authored The *Straightshooter's Guide to Marine Electronics*, a best seller on the marine dealer's bookshelf, and two videotapes on marine electronics and marine SSB communications.

Gordon is on the staff of Coastline College and Orange Coast College. He teaches evening ham radio classes and offers weekend ham radio licensing seminars.



The American Radio Relay League presented Gordon with the "Instructor of the Year" award. Through his own organization, Gordon West Radio School, Inc., he has trained one out of ten newly licensed hams over the last 20 years.

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